THE HEALTH OFFICER'S POCKET-BOOK

E. F. WILLOUGHBY, M.D.

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HEALTH OFFICER'S
POCKET-BOOK

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THE

HEALTH OFFICER'S POCKET-BOOK

A Guide to Sanitary Practice and Law

FOR

MEDICAL OFFICERS OF HEALTH
SANITARY INSPECTORS
MEMBERS OF SANITARY AUTHORITIES, ETC.

BY

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PREFACE TO FIRST EDITION.

To the man whose professional work is carried on for the most part away from his office, and not a little of it in the open air, some portable book of reference in which he may find in a moment most of the facts, formulæ, and data required in his daily practice is indispensable.

Engineers have long enjoyed a variety of such aids, some covering the entire field of their science and art, some dealing more exhaustively with a single department. But, while of the officers of a Sanitary Authority the Clerk is scarcely ever, and the Engineer or Surveyor rarely, called on to take action or to give his opinion impromptu, it is very different with the Medical Officer of Health; who, in addition to his special functions, must possess a general knowledge of physics, chemistry, engineering, building construction, and the conduct of many manufactures, as well as an accurate acquaintance with the provisions and working of a large mass of legal enactments, on which he must be always ready to act and advise officially or otherwise. In his narrower and more subordinate sphere the same applies to the Sanitary Inspector, whether in his capacity of assistant to the Medical Officer of Health or to the Surveyor; and every one engaged in practical sanitary work has often felt the want not only of a collection of such "facts, figures, and formulæ," as no man can always carry in his memory, but of an epitome of the essential points in the Acts of Parliament relating to the Public Health which shall enable him at any moment to ascertain the legal provisions bearing on the matter before him, the nature and extent of his powers, and the course to be followed in initiating proceedings.

This want I have endeavoured to supply in the present work, which accordingly consists of two divisions, one dealing with the scientific and technical details with which the Health Officer should be familiar, and the other with the legal enactments affecting his duties.

In the first part the mathematical and engineering tables, formulæ, &c., are, though of an elementary character, such as are contained in all similar works, to which recourse must be had for fuller information if necessary; but bearing in mind that the persons for whom I write are less likely than professional engineers to be familiar with the processes of algebra and trigonometry, I have given in addition short instructions for the solution of quadratic equations, extraction of roots, the nature and use of logarithms, solution of triangles, the use of factors, &c.

The chapter on meteorology is exclusively practical, but in that on statistics I have devoted what may seem to some a disproportionate space to indicating the important sociological conclusions to be drawn from birth and death rates, and to exposing the many fallacies into which all save the most judicious experts constantly fall.

The policy of the Local Government Board being very properly directed to the dissociation of the functions of the Analyst and of the Medical Officer of Health, I have confined myself to the simpler methods of examining air, water, milk, and certain foods, dwelling more on the interpretation of results than on the actual processes employed.

As in my previous work, "Hygiene and Public Health," I have given the latest conclusions of the Munich School on the *rôles* of the nitrogenous and non-nitrogenous food stuffs, on which much misapprehension prevails in this country.

The most exhaustive chapter is that on the duties of the Sanitary Inspector—the humblest, but not the least useful and responsible of Health Officers. The absence of any authoritative rule as to the qualifications of candidates for this office, as well as of institutions where they may acquire a sound and scientific knowledge of their duties, is a weak point in our sanitary administration, which, it is to be hoped, will be made good ere long.

The arrangement of the second or legal division of the book is, to a great extent, new. The Acts themselves contain a vast amount of matter relating to finance, administration, procedure in Parliament, &c., with which the Health Officer is in no way concerned.

The plan I have here adopted has been to bring together into the smallest possible compass the substance of every Act and Order in Council so far as it bears on the duties of the Health Officer; not only omitting all that is irrelevant or temporary, but further abridging the text by divesting it of all legal verbiage and repetition, and by the free use of initials and symbols for titles and phrases of frequent recurrence. The forms of notices and orders appended to the Acts I have, however, given verbatim, since the least deviation therefrom might, and in some cases certainly would, lead to the dismissal of the summons and perhaps to an action against the Sanitary Authority.

BRATTON LODGE,
GREEN LANES, N.
December 1892.

PREFACE TO SECOND EDITION.

Besides correcting the errors of the pen and press unavoidable in a work so full of numerical and technical details, I have thoroughly revised the text, substituting new matter wherever I felt that the old was in any degree inaccurate, superfluous, or of less practical value than that now put in its place.

I have accordingly given plain directions for the use of the staff, chain, and level in Surveying. In Demography, though it is unfortunately impossible to wait for the results of the coming census, I have substituted fuller and more recent statistics of the great towns of this and other countries, and inserted a table of the mortality from phthisis in England and Wales from 1861–96. The Sanitary Engineering sections have been almost rewritten, and descriptions of the septic tank, and recent improvements in the ventilation, warming, lighting, and water service of private houses, as well as the latest estimates for well boring and sinking, added. The new disinfectant, "Formalin," has been given a place beside "Sublimate," since they fulfil all possible requirements where heat is inapplicable, and though sulphurous and carbolic acids still find favour with Sanitary Authorities, they as well as chlorine, etc., have been thoroughly discredited among scientific men.

The old and imperfect methods of milk analysis and the examination of butter have been discarded in favour of those of Schmid, Gerber, and Stokes. A new and better selection of analyses of typical waters has been given, and all descriptions of domestic filters omitted except those of Pasteur-Chamberland and the Berkefeld, which only are really effective.

An entirely new section on the Bacteriological Examination of waters has been added, this being of far greater value than the chemical analysis. The *comparative* treatment of the Public Health Act of 1875, which I adopted in the first edition, in premature anticipation of the early passing of a new act for the provinces on the lines of that for London, is, I am aware, though instructive, not without certain inconveniences, but to have printed the whole of the Act in full would have added too greatly to the bulk and price of the book. I have, however, carefully revised the legal division, and brought it up to date, introducing the more recent Acts.

I have relegated to an Appendix a number of Schedules, etc., required by or useful to the Medical Officer of Health and Sanitary Inspector.

I do not pretend that the work is perfect, but remembering the favour with which the first edition, notwithstanding its many shortcomings, was received by Health Officers throughout the country, I venture to hope that my efforts at a searching revision will be rewarded by a still higher and wider appreciation.

E. F. W.

December 1901.

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NOTANDA ET CORRIGENDA.

Pages 127—129. The Factory and Workshop Acts of 1878 and 1883 were, together with others, repealed by the Factory and Workshop Act of 1901, passed after these sheets had gone to press, but which will be found in PART II (p. 341). The clauses with which the Health Officer is concerned are, however, unchanged, save in greater detail and stringency, and those referred to here are now numbered as follows:

1878.		1901.	1883.		1901.
Sec. 3	=	Sec. 1 (1)	Sec. 15	=	Sec. 97
,, 4	=	,, 5	,, 16	=	,, 98
,, 33	=	,, 1 (3)	,, 17	=	,, 102
,, 34	=	,, 99	,, 18		
,, 35	=	,, 100			

Page 149, line 7 from bottom. *For* short-branched sections *read* short branched sections.

Page 170, line 7 from bottom. *For* now, *read* no.

Page 176, line 27. *For* prevent, *read* preventing.

Page 192, line 23. *For* lime, *read* lead.

THE

HEALTH OFFICERS' POCKET-BOOK.

PART I.

PRACTICAL HYGIENE.

I. MATHEMATICAL PRACTICE.

METRICAL AND BRITISH WEIGHTS AND MEASURES.

THE French Metrical system is based upon the (assumed) length of the fourth part of a terrestrial meridian. The ten-millionth part of this arc was chosen as the unit of measures of length, and called a *Mètre*. The cube of the tenth part of the mètre was adopted as the unit of capacity, and denominated a *Litre*. The weight of a litre of distilled water at its greatest density was called a *Kilogramme*, of which the thousandth part, or *Gramme*, was adopted as the unit of weight. The multiples of these, proceeding in decimal progression, are distinguished by the employment of the prefixes *deca*, *hecto*, *kilo*, and rarely *myria*, from the Greek, and the subdivisions by *deci*, *centi*, and *milli*, from the Latin :—

Measures of Length (*unit Mètre*).

EQUAL TO	Inches.	Feet.	Yards.	Fathms.	Miles.
Millimètre	0·03937 ...	0·003 ...	0·001 ...	0·000 ...	0·000
Centimètre	0·39371 ...	0·032 ...	0·010 ...	0·005 ...	0·000
Décimètre	3·93708 ...	0·328 ...	0·109 ...	0·054 ...	0·000
MÈTRE	39·37079 ...	3·280 ...	1·094 ...	0·546 ...	0·000
Décamètre	393·70790 ...	32·808 ...	10·936 ...	5·468 ...	0·006
Hectomètre	3937·07900 ...	328·089 ...	109·363 ...	54·681 ...	0·062
Kilomètre	39870·79000 ...	3280·899 ...	1093·633 ...	546·816 ...	0·621

Cubic, or Measures of Capacity (*unit Litre*).

EQUAL TO	Cub. In.	Cub. Feet.	Pints.	Gallons.	Bshls.
Millilitre, or cubic centim.	0·06103...	0·000...	0·001...	0·000...	0·000
Centilitre, 10 cubic do.	0·61027...	0·000...	0·017...	0·002...	0·000
Décilitre, 100 cubic do.	6·10271...	0·003...	0·176...	0·022...	0·002
LITRE, or cubic Décimètre	61·02705...	0·035...	1·760...	0·220...	0·027
Décalitre, or Centistère	610·27052...	0·353...	17·607..	2·200...	0·275
Hectolitre, or Décistère	6102·70515...	3·531...	176·077...	22·009...	2·751
Kilolitre, cubic mètre.	61027·05152...	35·316...	1760·773...	220·096...	27·512

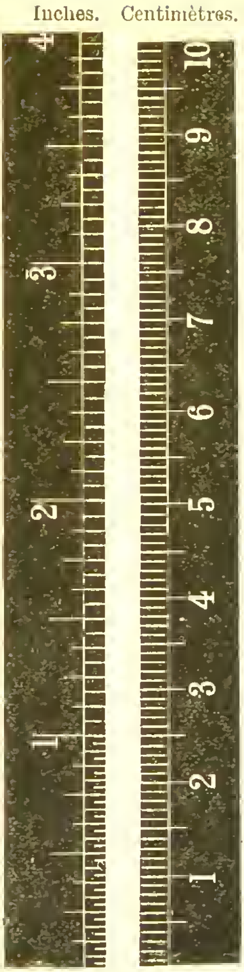


Fig. 1.

Measures of Weight (unit Gramme).

Equal to	Grains.	Troy oz.	Avoir. lb.
Milligramme	0·01543	0·000	0·000
Centigramme	0·15432	0·000	0·000
Décigramme	1·54323	0·003	0·000
Gramme	15·43235	0·032	0·002
Décagramme	154·32349	0·321	0·022
Hectogramme	1543·23488	3·215	0·220
Kilogramme	15432·34880	32·150	2·204

*Table for Converting Metric Weights and Measures.**

Mètre.		Yard.	Kilogr.		lb.avoir.	Litre.		Gallon.
0·914	**1**	1·094	0·454	**1**	2·20	4·54	**1**	0·22
1·829	**2**	2·187	0·907	**2**	4·41	9·09	**2**	0·44
2·743	**3**	3·281	1·361	**3**	6·61	13·63	**3**	0·66
3·658	**4**	4·374	1·814	**4**	8·82	18·17	**4**	0·88
4·572	**5**	5·468	2·268	**5**	11·02	22·72	**5**	1·10
5·486	**6**	6·562	2·722	**6**	13·23	27·26	**6**	1·32
6·401	**7**	7·655	3·175	**7**	15·43	31·80	**7**	1·54
7·315	**8**	8·749	3·629	**8**	17·64	36·35	**8**	1·76
8·229	**9**	9·843	4·082	**9**	19·84	40·89	**9**	1·98
9·144	**10**	10·936	4·536	**10**	22·05	45·43	**10**	2·20
18·288	**20**	21·873	9·072	**20**	44·09	90·87	**20**	4·40
27·432	**30**	32·809	13·608	**30**	66·14	136·30	**30**	6·60
36·576	**40**	43·745	18·144	**40**	88·18	181·74	**40**	8·80
45·719	**50**	54·682	22·679	**50**	110·23	227·17	**50**	11·00
54·863	**60**	65·618	27·215	**60**	132·28	272·61	**60**	13·20
64·007	**70**	76·554	31·752	**70**	154·32	318·04	**70**	15·40
73·151	**80**	87·491	36·288	**80**	176·37	363·48	**80**	17·60
82·295	**90**	98·427	40·823	**90**	198·42	408·91	**90**	19·80
91·438	**100**	109·363	45·359	**100**	220·46	454·35	**100**	22·01

* From Whitaker's Almanac, by permission of the proprietors. The tables are read thus—

1 mètre = 1·094 yards, and
1 yard = 0·914 mètre.

Mutual Conversion of Kilogrammes and Tons.

Kilogrammes × 0·0009 *will give* Tons.
Tons × 1011·8 *will give* Kilogrammes.

Sq. mètre ... 10·764299 sq. Feet, or 1·196 sq. Yards.
Hectare ... 2·471 Acres.

Kilomètres.		English miles.	Square Kilomètres.		Square English miles.	Hectare =10,000 sq. mèt.		Acre.	Cubic yards.		Cubic mètres.
1·609	**1**	0·621	2·592	**1**	0·386	0·405	**1**	2·471	1·306	**1**	0·7657
3·219	**2**	1·243	5·184	**2**	0·772	0·809	**2**	4·942	2·612	**2**	1·5314
4·828	**3**	1·864	7·776	**3**	1·158	1·214	**3**	7·413	3·918	**3**	2·296
6·438	**4**	2·486	10·368	**4**	1·544	1·619	**4**	9·885	5·224	**4**	3·063
8·047	**5**	3·107	12·960	**5**	1·930	2·023	**5**	12·356	6·530	**5**	3·8235
9·656	**6**	3·728	15·552	**6**	2·316	2·428	**6**	14·827	7·836	**6**	4·592
11·265	**7**	4·350	18·144	**7**	2·702	2·833	**7**	17·298	9·142	**7**	5·358
12·879	**8**	4·971	20·736	**8**	3·088	3·237	**8**	19·769	10·448	**8**	6·126
14·484	**9**	5·592	23·328	**9**	3·474	3·642	**9**	22·240	11·754	**9**	6·788
16·093	**10**	6·214	25·920	**10**	3·860	4·047	**10**	24·711	13·060	**10**	7·657
32·186	**20**	12·428	51·840	**20**	7·720	8·093	**20**	49·423	26·120	**20**	15·314
48·279	**30**	18·641	77·760	**30**	11·580	12·140	**30**	74·134	39·180	**30**	22·971
64·373	**40**	24·855	103·680	**40**	15·440	16·187	**40**	98·846	52·240	**40**	30·628
80·466	**50**	31·069	129·600	**50**	19·300	20·234	**50**	123·557	65·300	**50**	38·225
96·559	**60**	37·283	155·520	**60**	23·160	24·286	**60**	148·268	78·360	**60**	45·942
112·652	**70**	43·497	181·440	**70**	27·020	28·327	**70**	172·980	91·480	**70**	53·599
128·746	**80**	49·710	207·360	**80**	30·880	32·373	**80**	197·692	104·480	**80**	61·256
144·839	**90**	55·924	233·280	**90**	34·740	36·420	**90**	222·903	117·540	**90**	68·913
160·932	**100**	62·138	259·200	**100**	38·601	40·467	**100**	247·114	130·600	**100**	76·570

Other Equivalents.

10·7643 sq. ft.	**1**	0·0929 sq. mèt.
35·316 cub. ft.	**1**	0·0233 cub. mèt.
6·2322 gall.	**1**	0·1695 cub. ft.
1·76 pints	**1**	0·5679 litres.
15·432 grs.	**1**	0·0648 grms.

MENTAL CALENDAR.

Bear in mind on what day of the week New Year's Day fell.

(1) In ordinary years the first days in each quarter are as follow: April and July the day before, and October the same as January. In Leap-year, January, April, and July begin with the same day, and October with that after.

When a month has 28 days the next begins with the same day, when 29, 30, or 31 days, with one, two, or three days later. In each month the 1st, 8th, 15th, 22nd, and 29th fall on the same day of the week.

(2) To reckon lunar months, go back as many days as the preceding month exceeds 28.

Ex. (1) On what day will May 18, 1905, fall?
January 1, Sunday; April, Saturday; May, Monday, 1, 8, 15,—May 18 will be Thursday.

Ex. (2) On what day of the week will Michaelmas 1904 fall?
Leap-year, January 1, Friday; July 1, Friday; August 1, Monday; September 1, 8, 15 22, 29 will be Thursdays.

Ex. (3) Reckon six lunar months from January 6, 1904.
January 6, February 3, March 2, 30, April 27, May 25.
June 22 is six lunar months from January 6.

N.B.—Lady-day is the same as April 1, Midsummer-day as July 1, and Christmas as the New Year following. Many such constant relations may be noted and committed to memory as required.

PROPERTIES OF NUMBERS.

Divisibility of Numbers.

Any number is divisible by—

2 if the last digit be so.
3 if the sum of its digits be so.
4 if the two last digits be so.
5 if the last digit be 0 or 5.
6 if an even number and the sum of its digits be divisible by 3, *i. e.* if it be divisible by 2 and 3.
7 no rule of any practical use.
8 if the number formed by the last three digits be so.
9 if the sum of the digits be so.
10 if the last digit be 0.
11 if the difference between the sums of the alternate digits be 0 or any multiple of 11.
12 if the sum of the digits be divisible by 3 and the last two by 4.

Use of Arithmetical Factors.

In multiplication much time may be saved by this means: thus, if one have to multiply by 112567, instead of seven lines one may make three; viz. since $56 = 7 \times 8$, and $112 = 56 \times 2$, it is only necessary to multiply the number by 7, next this line by 8, and lastly this second line by 2, putting the second line one place further to the left than the first, and the third two places further than the second.

Interest may be worked as Practice, reducing the rate to fractions of £1 thus; $4\frac{1}{2}$ per cent. = 2 per cent. or $\frac{1}{50}$ and $2\frac{1}{2}$ per cent. or $\frac{1}{40}$.

G.C.M. of 2475, 3465 and 3960.

By the rules of divisibility we see that—

$$
\begin{aligned}
2475 &= 5 \times 5 \times 9 \times 11 \\
3465 &= 5 \times 7 \times 9 \times 11 \\
3960 &= 5 \times 8 \times 9 \times 11
\end{aligned}
$$

$$\therefore \text{G.C.M.} = 11 \times 9 \times 5 = 495.$$

L.C.M. of the same numbers.

Take each factor separately; note the greatest number of times that it occurs in any one: write each factor down that number of times, their product will be the L.C.M. Thus, 2 occurs three times, 5 twice, 9, 11, and 7, only once in any.

$$\therefore\ 2 \times 2 \times 2 \times 5 \times 5 \times 9 \times 11 \times 7 =$$
$$= 8 \times 25 \times 99 \times 7 = 1400 \times 99$$
$$= 140000 - 1400 = 138600.$$

Extraction of Square root.

No number can be a square if—

(1) It have an odd number of decimal places.

(2) Being a whole number it have an odd number of zeros at the end.

(3) The unit figure be 2, 3, 7, or 8.

If a number containing decimals be an exact square it will be so if the point be moved an even number of places to the right or the left, and the root will have the same figures in each case, the point moving half as many places in the same direction: but if the point be removed an odd number of places the root will be quite different.

The ordinary process may be much shortened by having recourse to common division when one figure more than half those in the root has been extracted.

The multiplication of large numbers of decimals, as in statistical practice, may be much simplified by keeping the points throughout in the same perpendicular, multiplying by the successive digits of the multiplier from *left to right*, giving them their true value as hundreds, tens, units, tenths, hundredths, etc., and so placing the products that the points and the corresponding digits, integral or decimal, shall be superposed, neglecting such as would carry the decimal places further than may be necessary in the particular instance.

It is necessary to ascertain the decimal place of the first line only of multiplication, then by crossing off the extreme figures of the multiplier and multiplicand, the next line of multiplication will start from the same place. In the annexed example, the decimals being required to be correct to the third place, it will be enough to take the multiplication to four places to allow for carrying; and if the figure cut off be 8 or 9, the last retained should be raised by one.

EXAMPLE.

1·863	57
13·745	2
18·635	7
5·590	5
1·304	1
·074	4
·009	0
·000	2
25·613	9

Answer 25·614

ALGEBRAIC PROCEDURE.

Algebraical Factors.

$$a^{m} \times a^{n} = a^{m+n} ; \quad \frac{a^{m}}{a^{n}} = a^{m-n}$$

$$(a^{m})^{n} = a^{mn} ; \quad a^{-n} = \frac{1}{a^{n}}$$

$$a^{m} b^{m} = (ab)^{m} ; \quad \sqrt[m]{a}\,\sqrt[m]{b} = \sqrt[m]{ab}$$

$$a^2 - b^2 = (a + b) \quad (a - b)$$

$$(a \pm b)^2 = a^2 \pm 2\,ab + b^2$$

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2\,ab + 2\,bc + 2\,ac$$

$$(a \pm b)^3 = a^3 \pm b^3 \pm 3\,ab\,(a \pm b) = a^3 \pm 3\,a^2 b + 3\,ab^2 \pm b^3$$

$$(a + b + c)^3 = a^3 + b^3 + c^3 + 3\,(a^2b + ab^2 + a^2c + ac^2 + b^2c + bc^2) + 6\,abc$$

$$a^3 \pm b^3 = (a \pm b) \quad (a^2 \mp ab + b^2)$$

$$\frac{a^3 \pm b^3}{a \pm b} = a^2 \mp ab + b^2$$

Quadratic Equations.

General form $x^2 + px - q = 0$

or $x^2 + px = q$

Add to each side $\left(\frac{p}{2}\right)^2 = \frac{p^2}{4}$

$$x^2 + px + \frac{p^2}{4} = \frac{p^2}{4} + q$$

The first side is now a complete square and

$$x + \frac{p}{2} = \pm \sqrt{\left(\frac{p^2}{4} + q\right)} \quad \text{Transposing}$$

$$x = -\frac{p}{2} \pm \sqrt{\left(\frac{p^2}{4} + q\right)}$$

Rule.—By transposition and reduction arrange the equation so that the terms involving x, the unknown quantity, are alone on one side, and the coefficient of x^2 is + 1. Add to both sides the square of half the coefficient of x, and extract the square root of both sides.

Roots are equal if $p^2 = 4\,q$
,, impossible if $p^2 < 4\,q$
,, possible and unequal if $p^2 > 4\,q$

Proportion.

$$a : b = c : d\,;\ \frac{a}{b} = \frac{c}{d}\,;\ ad = bc$$

$$b : a = d : c\,;\ \frac{b}{a} = \frac{d}{c}\,;\ a : c = b : d\,;\ \frac{a}{c} = \frac{b}{d}$$

$$a \pm b : b = c \pm d : d\,;\ \frac{a \pm b}{b} = \frac{c \pm d}{d}$$

$$a : a \pm b = c : c \pm d\,;\ \frac{a}{a \pm b} = \frac{c}{c \pm d}$$

$$a \pm b : a \mp b = c \pm d : c \mp d\,;\ \frac{a \pm b}{a \mp b} = \frac{c \pm d}{c \mp d}$$

If $a : b = b : c, \frac{a}{c} = \frac{a^2}{b^2}$ If $a : b = b : c = c : d, \frac{a}{d} = \frac{a^3}{b^3}$

Progression.

a = first term, l = last term, n = number of terms, s = sum of n terms, d common difference, r common ratio.

Arithmetic Progression.

n^{th} term $= a + (n - 1)\,d$

$$s = (a + l)\frac{n}{2} = (2\,a + (n - 1)\,d)\frac{n}{2}:$$

Arithmetic mean $= \dfrac{a + l}{2}$

Geometric Progression.

n^{th} term $= ar^{n-1}$; $S = a.\dfrac{r^n - 1}{r - 1}$;

Geometric mean $= \sqrt{al}$

Means and Averages.

Arithmetic mean $= \dfrac{a + b + c + d + \ .\ .\ .\ .\ l}{n}$

The sum of the differences of the terms greater than the mean = the sum of those less than the mean, or the algebraical sum of the differences = 0.

Quadratic mean of Radicke is the square root of the arithmetic mean of the squares of the terms.

$$\sqrt{\frac{a^2 + b^2 + c^2 + \ .\ .\ .\ l^2}{}}$$

Thus the arithmetic mean of $3 + 12 = \frac{3 + 12}{2} = 7 \cdot 5$, the quadratic mean $= \sqrt{\frac{9 + 144}{2}} = \sqrt{76 \cdot 5} = 8 \cdot 75$; arithmetic mean of 3, 9, and $2 = 6 \cdot 66$, the quadratic mean $= \sqrt{\frac{9+81+64}{3}}$ $= \sqrt{51 \cdot 33} = 7 \cdot 15$.

The arithmetic mean is applicable to three kinds of averages.

I. The pure average. Here the numbers are *exact*, and either independent of one another, or their dependence is not taken into account. Such are the mean ages of the persons forming a community; the mean temperature deduced from a series of observations, &c.

II. The *probable* value of a definite quantity, *e. g.* the determination of the percentages in chemical analyses. These have a real definite value, but since our observations are liable to error, we take the mean of a number, some of which probably exceed and others fall short of the truth, as the probable value or nearest possible approximation thereto.

III. The probable value of a variable quantity determined under mean conditions.

Such are the great majority of observations in physiology and in demography for estimating the influence exerted on the individual or on the community by a factor with which other unknown factors may co-operate or conflict.

Percentages.

The reduction of any given numbers to a common standard of percentages or the like is properly a question of proportion, for if among a population of 5250 the deaths in one year are 105, $5250 : 105 :: 1000 : x$, and $x = \frac{105 \times 1000}{5250} = 20$, *i. e.* the number of events × 100, 1000, &c., and ÷ the total number to which its ratio is sought, gives the rate per 100, 1000, &c. commonly written, p.c., p.m., or better, %, ‰, &c. In smaller groups the proportion may also be stated between the two subdivisions, *e. g.* if of 360 cases of cholera 120 end fatally, the deaths may be estimated on the total cases, or on the recoveries, thus $\frac{120 \times 100}{360} = 3\dot{3}$ per cent., or 1 in 3 of the cases, or $\frac{120 \times 100}{240} = 50$ per cent., or as 1 to 2 recoveries.

Errors and Corrections.

Assuming no single observation to be free from error, we may minimize the disturbing influence by extending the series indefinitely, or since this is rarely possible, by having recourse to the method of successive means, *i. e.* by taking the means of the first 2, first 3, first 4 . . . . up to the mean of the entire series. These will be found to agree in the first or first two or three figures, and so far may be accepted as true ; we then take the arithmetic mean of the later and differing figures, the greatest divergence of which from their arithmetic mean is the measure of uncertainty, and the mean of these errors is the mean error.

The algebraic sum of these errors being always 0, the arithmetic mean cannot be employed except by treating all the terms as positive, but the quadratic mean is preferable, for the value of any series is inversely as the extent of divergence among its terms. One in which the measure of uncertainty is only + 1 and − 1 is six times as probably near the truth as another in which the range is from + 6 to − 6, whereas the arithmetic means of the two series are the same.

In a series of sufficient length the probable error, according to the calculus of probabilities, is obtained by multiplying the mean error by ·67449, or ⅔ of the mean error.

The question may arise whether a series be sufficient to justify a conclusion, *e. g.* the death-rate of three or four consecutive years. To determine this, take the means of several such successive series ; if they differ appreciably the series are too short, *e. g.* the death-rate for 10 years having been, 22, 23, 21, 26, 23, 21, 22, 28, 22, and 21, the mean of the ten is 22·9, of the successive periods of three years, 22, 22·3, and 24. Three years is therefore too short a term. The means of five years, 23 and 22·8, however, differ little from that of the entire series, viz. 22·9.

Poisson's Formula.

To calculate the possible limits of error, or the degree of approximation to the truth, the somewhat hypothetical formula proposed by Poisson is occasionally employed. The total cases $= \mu$, and the constituent groups m and n, so that $\mu = m + n$, and the proportions which these bear to the whole are $\frac{m}{\mu}$ and $\frac{n}{\mu}$, which will, however, vary between certain limits represented thus

$$\frac{m}{\mu} + 2\sqrt{\frac{2.\,m.\,n}{\mu^3}}$$

$$\frac{m}{\mu} - 2\sqrt{\frac{2.\ m.\ n}{\mu^3}}$$

The greater the value of μ the less that of $\sqrt{\frac{2.\ m.\ n}{\mu^3}}$, and the less the limits of error in the proportion $\frac{m}{\mu}$.

There is also another form of error which may be called unavoidable, depending on the means or method of observation, and constantly positive or negative in each class of observations. One chemical process may tend to give a result always higher than the truth, and another always to under-estimate the value in question.

In vital statistics few if any deaths fail to be registered, whereas a certain percentage of births and a large proportion of the illegitimate are never recorded.

The unavoidable error approximately determined by empirical methods may be applied as a correction + or − to the totals or means obtained in the ordinary way.

"Means" and "Averages" compared.

These terms are frequently though erroneously employed indiscriminately, but they are not strictly synonymous. The *average* is the "mean of the actual number of instances," and is the datum from which in statistics the *mean rate* is calculated: thus if in a population of 80,000 the deaths from—*e. g.* scarlatina—for a number of years are 55, 20, 50, 45, and 30, the *average number* is 40, and the *mean rate* 0·5 per 1000. We use the word *mean* in its literal sense in the *mean age* at death, irrespective of the number of persons dying, but speak of the *average number* of rainy days in a year, since all years are of equal length; if, however, this average were, *e. g.* 91, we might say that the *mean ratio* of rainy to fine days was as 1 : 3.

Generally speaking, *averages* represent actual or concrete numbers, while *means* are purely mental conceptions. Thus in the last example we may as a rule expect to have 90 days on which rain will fall; but though this may be described as 25 per cent., or 1 in 4, it is highly improbable that this proportion will be observed in any one or more successive periods of 4 days each. The *mean age* at death of a population may be 45, though not one in a thousand may die precisely at that age; but the duration of enteric fever may properly be said to be 28 days on an *average*, since the majority of cases last one month, comparatively few exceeding or falling short of that period, and even these falling within narrow limits either way.

Squares and Cubes, Square Roots and Cube Roots.

No.	Sq.	Cube.	Square Root.	Cube Root.	No.	Sq.	Cube.	Square Root.	Cube Root.
1	1	1	1·00000	1·00000	51	2601	132651	7·14143	3·7084
2	4	8	1·41421	1·2599	52	2704	140608	7·21110	3·7325
3	9	27	1·73205	1·4423	53	2809	148877	7·28011	3·7563
4	16	64	2·00000	1·5874	54	2916	157464	7·34847	3·7798
5	25	125	2·23607	1·7099	55	3025	166375	7·41620	3·8029
6	36	216	2·44949	1·8171	56	3136	175616	7·48332	3·8259
7	49	343	2·64575	1·9129	57	3249	185193	7·54983	3·8485
8	64	512	2·82843	2·0000	58	3364	195112	7·61577	3·8709
9	81	729	3·00000	2·0801	59	3481	205379	7·68115	3·8930
10	100	1000	3·16228	2·1544	60	3600	216000	7·74597	3·9149
11	121	1331	3·31663	2·2239	61	3721	226981	7·81025	3·9365
12	144	1728	3·46410	2·2894	62	3844	238328	7·87401	3·9579
13	169	2197	3·60555	2·3513	63	3969	250047	7·93725	3·9791
14	196	2744	3·74166	2·4101	64	4096	262144	8·00000	4·0000
15	225	3375	3·87298	2·4662	65	4225	274625	8·06226	4·0207
16	256	4096	4·00000	2·5198	66	4356	287496	8·12404	4·0412
17	289	4913	4·12311	2·5713	67	4489	300763	8·18535	4·0615
18	324	5832	4·24264	2·6207	68	4624	314432	8·24621	4·0817
19	361	6859	4·35890	2·6684	69	4761	328509	8·30662	4·1016
20	400	8000	4·47214	2·7144	70	4900	343000	8·36660	4·1213
21	441	9261	4·58258	2·7589	71	5041	357911	8·42615	4·1408
22	484	10648	4·69042	2·8020	72	5184	373248	8·48528	4·1602
23	529	12167	4·79583	2·8439	73	5329	389017	8·54400	4·1793
24	576	13824	4·89898	2·8845	74	5476	405224	8·60233	4·1983
25	625	15625	5·00000	2·9240	75	5625	421875	8·66025	4·2172
26	676	17576	5·09902	2·9625	76	5776	438976	8·71779	4·2358
27	729	19683	5·19615	3·0000	77	5929	456533	8·77496	4·2543
28	784	21952	5·29150	3·0366	78	6084	474552	8·83176	4·2727
29	841	24389	5·38517	3·0723	79	6241	493039	8·88819	4·2908
30	900	27000	5·47723	3·1072	80	6400	512000	8·94400	4·3089
31	961	29791	5·56776	3·1414	81	6561	531441	9·00000	4·3267
32	1024	32768	5·65685	3·1748	82	6724	551368	9·05589	4·3445
33	1089	35937	5·74456	3·2075	83	6889	571787	9·11043	4·3621
34	1156	39304	5·83095	3·2396	84	7056	592704	9·16515	4·3795
35	1225	42875	5·91608	3·2711	85	7225	614125	9·21955	4·3968
36	1296	46656	6·00000	3·3019	86	7396	636056	9·27362	4·4141
37	1369	50653	6·02876	3·3322	87	7569	658503	9·32738	4·4314
38	1444	54872	6·16441	3·3619	88	7744	681472	9·38083	4·4479
39	1521	59319	6·24500	3·3912	89	7921	704969	9·43398	4·4647
40	1600	64000	6·32456	3·4199	90	8100	729000	9·48683	4·4814
41	1681	68921	6·40312	3·4482	91	8281	753571	9·53939	4·4979
42	1764	74088	6·48074	3·4760	92	8464	778688	9·59166	4·5144
43	1849	79507	6·55744	3·5034	93	8649	804357	9·64365	4·5307
44	1936	85184	6·63325	3·5303	94	8836	830584	9·69536	4·5468
45	2025	91125	6·70820	3·5569	95	9025	857375	9·74679	4·5629
46	2116	97336	6·78230	3·5330	96	9216	884736	9·79796	4·5789
47	2209	103823	6·85566	3·6088	97	9409	912673	9·84886	4·5947
48	2304	110592	6·92820	3·6342	98	9604	941192	9·89949	4·6104
49	2401	117649	7·00000	3·6590	99	9801	970299	9·94987	4·6261
50	2500	125000	7·07107	3·6840	100	10000	1000000	10·00000	4·6416

Logarithms of Numbers 0—1000.

No.	0	1	2	3	4	5	6	7	8	9	DF
0	0	00000	30103	47712	60206	69897	77815	84510	90309	95424	
10	00000	00432	00360	01284	01703	02119	02530	02938	03342	03743	415
11	04139	04532	04922	05307	05690	06070	06446	06819	07188	07555	379
12	07918	08279	08637	08990	09342	09601	10037	10380	10721	11059	344
13	11394	11729	12057	12385	12710	13033	13354	13672	13988	14301	323
14	14613	14922	15229	15533	15836	16137	16435	16732	17026	17319	298
15	17609	17898	18184	13469	18752	19033	19312	19590	19866	20140	281
16	20412	20683	20952	21219	21484	21748	22011	22272	22531	22789	264
17	23045	23300	23553	23805	24055	24304	24551	24797	25042	25285	249
18	25527	25768	26007	26245	26482	26717	26951	27184	27416	27646	234
19	27875	28103	28330	28556	28780	29003	29226	29447	29667	29885	222
20	30103	30320	30535	30749	30963	31175	31386	31597	31806	32015	212
21	32222	32428	32633	32838	33041	33244	33445	33646	33846	34044	202
22	34242	34439	34635	34830	35025	35218	35411	35603	35793	35984	193
23	36173	36361	36549	36736	36922	37107	37291	37475	37658	37840	185
24	38021	38202	38382	38561	38739	38916	39094	39270	39445	39619	177
25	39794	39967	40140	40312	40483	40654	40824	40993	41162	41330	170
26	41497	41664	41830	41996	42160	42325	42488	42651	42813	42975	164
27	43136	43297	43457	43616	43775	43933	44091	44248	44404	44560	158
28	44716	44871	45025	45179	45332	45484	45637	45788	45939	46090	153
29	46240	46389	46538	46678	46835	46982	47129	47276	47422	47567	148
30	47712	47857	48001	48144	48287	48430	48572	48714	48855	48996	143
31	49136	49276	49415	49554	49693	49831	49969	50106	50243	50379	138
32	50515	50651	50786	50920	51055	51189	51322	51455	51587	51720	134
33	51851	51983	52114	52244	52375	52504	52634	52763	52892	53020	130
34	53148	53275	53403	53529	53656	53782	53908	54033	54158	54283	126
35	54407	54531	54654	54777	54900	55022	55145	55267	55388	55509	122
36	55630	55751	55871	55991	56110	56229	56348	56467	56585	56703	119
37	56820	56937	57054	57171	57287	57403	57519	57634	57749	57863	116
38	57978	58093	58206	58320	58433	58546	58659	58771	58883	58995	113
39	59106	59218	59328	59439	59550	59660	59770	59879	59989	60097	110
40	60206	60314	60423	60531	60638	60745	60853	60959	61066	61172	107
41	61278	61384	61490	61595	61700	61805	61909	62014	62118	62221	104
42	62325	62428	62531	62634	62737	62839	62941	63043	63144	63246	102
43	63347	63448	63548	63649	63749	63849	63949	64048	64147	64246	99
44	64345	64444	64542	64640	64738	64836	64933	65031	65128	65225	98
45	65321	65418	65514	65609	65706	65801	65896	65992	66087	66181	96
46	66276	66370	66464	66558	66652	66745	66839	66932	67025	67117	95
47	67210	67302	67394	67486	67578	67669	67761	67852	67943	68034	92
48	68124	68215	68305	68395	68485	68574	68664	68753	68842	68931	90
49	69020	69108	69197	69285	69373	69461	69548	69636	69723	69810	88
50	69897	69984	70070	70157	70243	70329	70415	70501	70586	70672	86
51	70757	70842	70927	71012	71096	71181	71265	71349	71433	71517	84
52	71600	71684	71767	71850	71933	72016	72099	72181	72263	72346	82
53	72428	72509	72591	72673	72754	72835	72916	72997	73078	73159	81
54	73239	73320	73309	73480	73560	73639	73719	73799	73878	73957	80
55	74036	74115	74194	74273	74351	74429	74507	74586	74663	74741	78
56	74819	74806	74974	75051	75128	75205	75282	75358	75435	75511	77
57	75587	75664	75740	75813	75891	75967	76042	76118	76193	76268	75
58	76343	76418	76492	76567	76641	76716	76790	76864	76938	77012	74
59	77085	77159	77232	77305	77379	77452	77525	77597	77670	77743	73
60	77815	77887	77960	78032	78104	78176	78247	78319	78390	78462	72

Logarithms of Numbers 0—1000 (*continued*).

No.	0	1	2	3	4	5	6	7	8	9	DF
61	78533	78604	78675	78746	78817	78888	78958	79029	79099	79168	71
62	79239	79309	79379	79449	79518	79588	79657	79727	79796	79865	70
63	79934	80003	80072	80140	80209	80277	80346	80414	80482	80550	69
64	80618	80686	80754	80821	80889	80956	81023	81090	81158	81224	68
65	81291	81858	81425	81491	81558	81624	81690	81757	81823	81889	67
66	81954	82020	82086	82151	82217	82282	82347	82413	82478	82543	66
67	82607	82672	82737	82802	82866	82930	82995	83059	83123	83187	64
68	83251	83315	83378	83442	83506	83569	83632	83696	83759	83822	63
69	83885	83948	84011	84073	84136	84198	84261	84323	84386	84448	63
70	84510	84572	84634	84696	84757	84819	84880	84942	85003	85065	62
71	85126	85187	85248	85309	85370	85431	85491	85552	85612	85673	61
72	35733	85794	85854	85914	85974	86034	86094	86153	86213	86273	60
73	86332	86392	86451	86510	86570	86629	86688	86747	86806	86864	59
74	86923	86982	87040	87099	87157	87216	87274	87332	87390	87448	58
75	87506	87564	87622	87680	87737	87795	87852	87910	87967	88024	57
76	88081	88138	88196	88252	88309	88366	88423	88480	88536	88593	57
77	88649	88705	88762	88818	88874	88930	88986	89042	89098	89154	56
78	89209	89265	89321	89376	89432	89487	89542	89597	89653	89708	55
79	89763	89818	89873	89927	89982	90037	90091	90146	90200	90255	54
80	90309	90363	90417	90472	90526	90580	90634	90687	90741	90795	54
81	90848	90902	90956	91009	91062	91116	91169	91222	91275	91328	53
82	91381	91434	91487	91540	91593	91645	91698	91751	91803	91855	53
83	91908	91960	92012	92065	92117	92169	92221	92273	92324	92376	52
84	92428	92480	92531	92583	92634	92686	92737	92789	92840	92891	51
85	92942	92993	93044	93095	93146	93197	93247	93298	93349	93399	51
86	93450	93500	93551	93601	93651	93702	93752	93802	93852	93902	50
87	93952	94002	94052	94101	94151	94201	94250	94300	94349	94398	49
88	94448	94498	94547	94596	94645	94694	94743	94792	94841	94899	49
89	94939	94988	95036	95085	95134	95182	95231	95279	95328	95376	48
90	95424	95472	95521	95569	95617	95665	95713	95761	95809	95856	48
91	95904	95952	95999	96047	96095	96142	96190	96237	96284	96332	48
92	96379	96426	96473	96520	96567	96614	96661	96708	96755	96802	47
93	96848	96895	96942	96988	97035	97081	97128	97174	97220	97267	47
94	97313	97359	97405	97451	97497	97543	97589	95635	97681	97727	46
95	97772	97818	97864	97909	97955	98000	98046	98091	98137	98182	46
96	98227	98272	98318	98363	98408	98453	98498	98543	98588	98632	45
97	98677	98722	98767	98811	98856	98900	98945	98989	99034	99078	45
98	99123	99167	99211	99255	99300	99344	99388	99432	99476	99520	44
99	99564	99607	99651	99695	99739	99782	99826	99870	99913	99957	44
100											

⁂ *Note.*—The above Tables (pp. 11 to 13) are reproduced from Sir G. Molesworth's *Pocket-Book*.

Use of Logarithmic Tables.

The logarithm of a number is the power of 10 which it represents ; thus 10 is the 1st power ∴ logarithm 10 = 1 ; 100 is the 2nd power (or square) ∴ logarithm 100 = 2 ; 1000 is the

3rd power (or cube) ∴ logarithm 1000 = 3. Intermediate numbers may be conceived as fractional powers, thus 32 is very nearly the $1\frac{1}{2}$ power and its logarithm = 1·5.

Logarithms are used to facilitate arithmetical computations, since (1) the logarithm of a product = the sum of the logarithms of its factors; (2) the logarithm of a quotient = logarithm of the dividend − logarithm of the divisor; (3) the logarithm of any power of a number = logarithm of the number × index of the power; and (4) the logarithm of any root of a number = the log. of the number ÷ the index of the root.

Thus (1) to multiply any numbers add their logarithms, the sum = logarithm of product; (2) to divide, subtract logarithm of divisor from logarithm of dividend, the remainder = logarithm of quotient; (3) to find any power of a number multiply its logarithm into the index of the power, the product is the logarithm of the power required; and (4) to find the root, divide the log. of the number by the index of the root, the quotient is the log. of the root required.

To find the logarithm of a given number.

If the number be in the table take the logarithm therein for the decimal part or *mantissa*, and prefix the integer or *characteristic*, 1, 2, 3 . . . according as the number amounts to tens, hundreds, thousands, &c. If the number itself be a decimal less than unity, the characteristic will be a negative quantity expressed as $\bar{1}$, $\bar{2}$, $\bar{3}$, thus for the logarithm of 534 in line 53 in the column under 4 will be found the logarithm 72754, and the number being one of hundreds the characteristic will be 2. The logarithm of 534 therefore is 2·72754, so logarithm 53400 is 4·72754, and logarithm ·0534 is $\bar{2}$·72754.

If, however, the exact number be not in the table, as *e. g.* 5065 the nearest will be in line 50, column under 6, or 5060, the logarithm of which is 3·70415, the difference between this and 5065 being 5. Multiply 5 into the differential factor in the last column of line 50, *viz.* 86, and add the product 5 × 86 = 430, but one place further to the right, since the number 5065 was four digits and the table extends to three only. Thus—

Find logarithm 5065
Logarithm 5060 = 3·70415
Difference 5 × Differential Factor 86 = 430
Logarithm 5065 = 3·70458

If the number extend to five, six or more places, the nearest in the table will have to be extended by ciphers, and the difference will run up to two, three or more digits. Each of these must be multiplied into the differential factor, and the products be carried successively one place further to the right than the preceding, *i. e.* the product of the units than that of the tens and of the tens than that of the hundreds, so that the mantissa shall extend to six, seven or more places.

If the number be mixed, comprising an integral and a decimal part, drop the decimal point, proceed as above, and then prefix the proper characteristic to the logarithm. Thus—

logarithm 0·234534 = $\bar{1}$·370207 and
logarithm 234·534 = 2·370207

To find the number corresponding to a given logarithm.

If the decimal part of the logarithm be found in the table it is necessary only to put the decimal point, if any, required in the place determined by the characteristic. Thus the number corresponding to the logarithm 72754 is 534, but that to $\bar{1}$·72754 will be ·0534, for as many ciphers must be prefixed, as there are negative powers indicated in the logarithm.

If the logarithm required be not in the table, find the next higher logarithm, and the next lower, and *divide* the difference by the differential factor. Thus—

Find number of logarithm 3·771442
Logarithm of 5900 = 3·770850
Difference = 592

Difference 592 ÷ differential factor 73 = 8, which added to 5900 gives the number required, 5908.

MENSURATION.

Angles, Arcs, Chords, and Perimeters.

$$\left.\begin{aligned} d &= \text{diameter of circle} \\ r &= \text{radius of a circle} \\ r &= \frac{d}{2};\ d = 2r \end{aligned}\right\}\ \pi = \frac{\text{circumference}}{\text{diameter}}$$

$$\pi = 3\cdot14159 \text{ or } 3\cdot1416 = 3\tfrac{1}{7}$$

A = interior angles of a regular figure of n sides.

$$A^\circ = \frac{n-2}{n} \times 180^\circ$$

Thus in a pentagon A° = 108°
,, ,, hexagon A° = 120°
,, ,, octagon A° = 135°

Chord of a circle subtending A°

$$= 2r.\ \text{sin.}\ \frac{A}{2}$$

Arc of circle subtending A°

$$= \frac{A}{180} \times \pi\, r$$

Perimeter (circumference) of a circle $= 2\,\pi\, r = \pi\, d$

Perimeter of ellipse, semiaxes a and b, $= \pi\,(a + b)$ approximately.

Areas.

Area of rectangle, sides a and b, $= ab$.

Area of parallelogram, sides a and b including $\angle$ A, $= ab$ sin. A°.

Area of triangle, sides a, b and base c

$$\text{Altitude } p,\ \frac{\text{sum of sides}}{2} = s$$

Angle subtended by base = C

$$\text{Area} = \frac{c\,p}{2} = \frac{ab \sin.\ C}{2}$$

$$= \sqrt{s\,(s - a)\ (s - b)\ (s - c)}$$

where s = half the sum of the sides.

Area of trapezium, altitude p, parallel sides a, b

$$= \frac{p\,(a + b)}{2}$$

Area of polygon of n sides each $= a$

$$= n \times \frac{a^2}{4} \times \cot.\ \frac{180}{n}$$

Area of circle

$$= \pi r^2 = \frac{\pi\, d^2}{4} = \frac{C^2 r}{2}$$

Area of annulus, exterior and interior radii R, r

$$= \pi\,(R^2 - r^2)$$

Area of circular sector $\angle$ A

$$= \frac{\text{arc} \times r}{2} = \pi r^2 \times \frac{A°}{360}$$

Area of circular segment

$$= \text{area of sector} - \text{area of triangle}$$

$$= \pi r^2 \frac{A}{360} - \frac{r^2 \sin.\ A}{2}$$

$$= \frac{2 \text{ chord} \times \text{height}}{3} + \frac{\text{height}^3}{2 \text{ chord}}$$

Area ellipse, semiaxes a and b

$$= \pi ab$$

Surfaces.

Surface of sphere = $4\pi r^2$

Surface of cylinder = $2\pi rh$ height, h

Surface of prism = Ph perimeter of base, P

Surface of cone or pyramid = $\frac{1}{2}$ perimeter of base × slant height

Surface of spherical segment, = $2\pi r h$

Volumes.

Vol. of rectangular parallelopided, sides, a, b, c, = abc

Vol. of cylinder or prism, A being area of base, and h the height, = Ah

Vol. of sphere $= \frac{4\pi r^3}{3} = \frac{2}{3} \times$ vol. of circumscribing cylinder

Vol. of cone or pyramid $= \frac{Ah}{3}$

Vol. of spherical segment $= \frac{\pi}{3}(3r - h)h^2$

PLANE TRIGONOMETRY.

Properties of Rectilinear Angles.

In right-angled triangles the angle A is contained by the hypothenuse and base, and is subtended by the perpendicular.

Let H = hypothenuse, P = perpendicular, and B = base

$$H = \sqrt{P^2 + B^2}$$

$$P = \sqrt{H^2 - B^2} = \sqrt{(H + B)(H - B)}$$

$$B = \sqrt{H^2 - P^2} = \sqrt{(H + P)(H - P)}$$

Diagonal of a square = side × $\sqrt{2}$ or $d = a\sqrt{2} = a \times 1{\cdot}414$

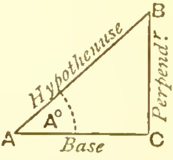


FIG. 2.

Let a, b, c be the sides subtended by the angles A, B, C,

and $S = \frac{a + b + c}{2}$

Area $= \sqrt{S(S - a)(S - b)(S - c)}$

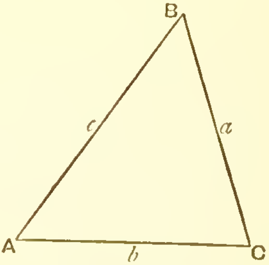


FIG. 3.

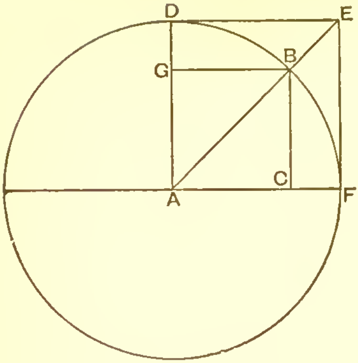


FIG. 4.

$$\text{Sin. } A^\circ = \frac{\text{Perp.}}{\text{Hyp.}} = \frac{BC}{AB}$$

$$\text{Cos. } A^\circ = \frac{\text{Base}}{\text{Hyp.}} = \frac{AC}{AB}$$

$$\text{Tan. } A^\circ = \frac{\text{Perp.}}{\text{Base}} = \frac{BC}{AC}$$

$$\textit{i. e. } \frac{EF}{AF}$$

$$\text{Cosec.} = \frac{\text{Hyp.}}{\text{Perp.}} = \frac{AB}{BC} = \frac{1}{\text{Sin. } A}$$

$$\text{Sec. } A = \frac{\text{Hyp.}}{\text{Base}} = \frac{AB}{AC} = \frac{1}{\text{Cos. } A}$$

$$\text{Cot. } A = \frac{\text{Base}}{\text{Perp.}} = \frac{AC}{BC} \textit{ i. e. } \frac{AF}{EF} = \frac{1}{\text{Tan. } A}$$

$$\text{Vers. Sin. } H^\circ = \frac{\text{Hyp.} - \text{Base}}{\text{Hyp.}} = \frac{AB - AC}{AB} \textit{ i. e. } \frac{AF - AC}{AB}$$

$$\text{or } \frac{CF}{AB}$$

$$\text{Covers. Sin. } A^\circ = \frac{\text{Hyp.} - \text{Perp.}}{\text{Hyp.}} = \frac{AB - BC}{AB} \textit{ i. e. } \frac{DG}{AB}$$

Trigonometrical equivalents in common use.

Sin. A =	Cos. A =	Tan. A=	Cot. A	Sec. A	Cosec. A
$=\sqrt{1-\text{Cos.}^2 A}$	$=\sqrt{1-\text{Sin.}^2 A}$				
$=\frac{\text{Tan. } A}{\text{Sec. } A}$	$=\frac{\text{Sin. } A}{\text{Tan. } A}$	$=\frac{\text{Sin. } A}{\text{Cos. } A}$	$=\frac{\text{Cos. } A}{\text{Sin. } A}$	$=\frac{\text{tan. } A}{\text{Sin. } A}$	
$=\frac{\text{Cos. } A}{\text{Cot. } A}$	$=\text{Sin. } A. \text{ Cot. } A$				
$=\frac{1}{\text{Cosec. } A}$	$=\frac{1}{\text{Sec. } A}$			$=\frac{1}{\text{Cos. } A}$	$=\frac{1}{\text{Sin. } A}$
		$=\frac{1}{\text{Cot. } A}$	$=\frac{1}{\text{tan. } A}$		
$=\frac{\text{tan. } A}{\sqrt{1+\text{tan.}^2 A}}$	$=\frac{1}{\sqrt{1+\text{tan.}^2 A}}$			$=\sqrt{1+\text{tan.}^2 A}$	$=\sqrt{1+\text{Cot.}^2 A}$

$$\text{Sin.}^2 A + \text{Cos.}^2 A = \text{Tan. } A \times \text{Cot. } A = 1 = \text{Radius.}$$

Versed Sin. A = 1 − Cos. A.	Coversed Sin. A = 1 − Sin. A.

Numerical values of ratios of frequent occurrence.

$\text{Sin. } 30^\circ = \text{Cos. } 60^\circ = \frac{1}{2}$ and $\text{Cosec. } 30^\circ = \text{Sec. } 60^\circ = 2$

$\text{Cos. } 30^\circ = \text{Sin. } 60^\circ = \frac{\sqrt{3}}{2}$,, $\text{Sec. } 30^\circ = \text{Cosec. } 60^\circ = \frac{2}{\sqrt{3}}$

$\text{Tan. } 30^\circ = \text{Cot. } 60^\circ = \frac{1}{\sqrt{3}}$,, $\text{Cot. } 30^\circ = \text{Tan. } 60^\circ = \sqrt{3}$

$\text{Sin. } 45^\circ = \text{Cos. } 45^\circ = \frac{1}{\sqrt{2}}$,, $\text{Sec. } 45^\circ = \text{Cosec. } 45^\circ = \sqrt{2}$

$\text{Sin. } 15^\circ = \text{Cos. } 75^\circ = \frac{\sqrt{3}-1}{2\sqrt{2}}$,, $\text{Cos. } 15^\circ = \text{Sin. } 75^\circ = \frac{\sqrt{3}+1}{2\sqrt{2}}$

$\text{Sin. } 78^\circ = \text{Cos. } 72^\circ = \frac{\sqrt{5}-1}{4}$,, $\text{Sin. } 54^\circ = \text{Cos. } 36^\circ = \frac{\sqrt{5}+1}{4}$

$\text{Tan. } 45^\circ = \text{Cot. } 45^\circ = 1$; | $\text{Tan. } 15^\circ = \text{Cot. } 75^\circ = 2 - \sqrt{3}$

Solution of Triangles.

a, b, and c, are the sides severally subtended by the angles A, B, and C.

(1) The sides of a triangle are proportional to the sines of the opposite angles.

$$\frac{\text{Sin. A}}{a} = \frac{\text{Sin. B}}{b} = \frac{\text{Sin. C.}}{c}$$

$$\text{or Sin. A} : \text{Sin. B} : \text{Sin. C} = a : b : c.$$

$$\text{Cos. A} = \frac{b^2 + c^2 - a^2}{2\,bc}$$

(2) $a^2 = b^2 + c^2 - 2\,bc \text{ Cos. A.}$

$c = a \text{ Cos. B} + b \text{ Cos. A.}$

(2*) In right-angled triangles $\text{A} = 90^\circ$ and $\text{Cos. A} = 0$.

$\therefore a^2 = b^2 + c^2$, and $a = \sqrt{b^2 + c^2}$

$b^2 = a^2 - c^2$ and $b = \sqrt{a^2 - c^2}$ &c.

(3) Given two angles and the intervening side, or A, C, and b.

$$a = b\,\frac{\text{Sin. A}}{\text{Sin. B}} \qquad c = b\,\frac{\text{Sin. C}}{\text{Sin. B}}$$

(4) Given two angles and an opposite side, or A, C, and a.

$$b = a\,\frac{\text{Sin. B}}{\text{Sin. A}} \qquad c = a\,\frac{\text{Sin. C}'}{\text{Sin. A}}$$

(5) Given two sides and the included angle, or a, b, and C.

$$(\alpha) \qquad \tan.\ \frac{A - B}{2} = \frac{a - b}{a + b} \cot.\ \frac{C}{2}$$

A + B = 180° − C ; A − B is determined from α.

$$(\beta)\ A = \frac{A + B}{2} + \frac{A - B}{2};\ B = \frac{A + B}{2} - \frac{A + B}{2}$$

$$(\gamma) \qquad c = a \frac{\text{Sin. C}}{\text{Sin. A}}$$

$$S = \frac{a + b + c}{2}$$

(6) Given all the sides a, b, and c.

$$\text{Sin. A} = \frac{2}{bc} \sqrt{S\,(S - a)\ \ (S - b)\ \ (S - c)}$$

(7) Area of any plane triangle.

$$= \frac{bc\ \text{Sin. A}}{2} = \frac{ab\ \text{Sin. C}}{2} = \frac{ac\ \text{Sin. B}}{2}$$

$$= \sqrt{S\,(S - a)\ \ (S - b)\ \ (S - c)}$$

Surveying.

The mensuration and trigonometry given above, with a little plane geometry, comprises all that the surveyor can need in his ordinary work ; and the sanitary officer will find the chain and staff, with level compass and a sextant, amply sufficient, the theodolite being required in more extensive operations only. But the use of these and the making of the field-book must be learnt practically.

Linear measures in Land Surveying.

Links.	Feet.	Yards.	Poles.	Chains.	Furlongs.	Mile.
25	16½	5½	1			
100	66	22	4	1		
1000	660	220	40	10	1	
3000	5280	1760	320	80	8	1

Square measures in Land Surveying.

Sq. Links.	Sq. Feet.	Sq. Yards.	Sq. Poles or Perches.	Sq. Chains.	Roods.	Acre.
625	272¼	30¼	1			
10,000	4356	484	16	1		
25,000	10,890	1210	40	2½	1	
100,000	43,560	4840	160	10	4	1

The horizontal distance between two points at different elevations is less than that measured on the surface of the ground, as the base is than the hypothenuse, or as the cosine of the angle of inclination is to 1. But where the gradients are fairly regular for considerable distances the corrections may be made by means of the following table.

Reduction in every 100 *links for every* ½ *degree of incline.*

Angle.	Reduction.	Angle.	Reduction.	Angle.	Reduction.
3° 0′	0·15	9° 0′	1·23	15° 0′	3·41
3° 30′	0·19	9° 30′	1·37	15° 30′	3·64
4° 0′	0·24	10° 0′	1·53	16° 0′	3·87
4° 30′	0·31	10° 30′	1·67	16° 30′	4·12
5° 0′	0·38	11° 0′	1·84	17° 0′	4·37
5° 30′	0·46	11° 30′	2·01	17° 30′	4·63
6° 0′	0·55	12° 0′	2·19	18° 0′	4·89
6° 30′	0·64	12° 30′	2·37	18° 30′	5·17
7° 0′	0·75	13° 0′	2·56	19° 0′	5·45
7° 30′	0·86	13° 30′	2·76	19° 30′	5·74
8° 0′	0·97	14° 0′	2·97	20° 0′	6·03
8° 30′	1·10	14° 30′	3·19	20° 30′	6·33

Table of Natural Sines, &c. of Angles 0°—90°.

Deg.	Sine.	Coversed Sine.	Cosec.	Tangent.	Cotangent.	Secant.	Versed Sine.	Cosine.	
0	·00000	1·00000	∞	0·00000	∞	1·00000	·0000	1·00000	90
1	·01745	·98254	57·2986	·01745	57·2899	1·00015	·0001	·99984	89
2	·03489	·96510	28·6537	·03492	28·6362	1·00060	·0006	·99939	88
3	·05233	·94766	19·1073	·05240	19·0811	1·00137	·0013	·99862	87
4	·06975	·93024	14·3355	·06992	14·3006	1·00244	·0024	·99756	86
5	·08715	·91284	11·4737	·08748	11·4300	1·00381	·0038	·99619	85
6	·10452	·89547	9·5667	·10510	9·5143	1·00500	·0054	·99452	84
7	·12186	·87813	8·2055	·12278	8·1443	1·00750	·0074	·99254	83
8	·13917	·86082	7·1852	·14054	7·1153	1·00982	·0097	·99026	82
9	·15643	·84356	6·3924	·15838	6·3137	1·01246	·0123	·98768	81
10	·17364	·82635	5·7587	·17632	5·6712	1·01542	·0151	·98480	80
11	·19080	·80919	5·2408	·19438	5·1445	1·01871	·0183	·98162	79
12	·20791	·79208	4·8097	·21255	4·7046	1·02234	·0218	·97814	78
13	·22495	·77504	4·4454	·23086	4·3314	1·02630	·0256	·97437	77
14	·24192	·75807	4·1335	·24932	4·0107	1·03061	·0297	·97029	76
15	·25881	·74118	3·8637	·26794	3·7320	1·03527	·0340	·96592	75
16	·27563	·72436	3·6279	·28764	3·4874	1·04029	·0387	·96126	74
17	·29237	·70762	3·4203	·30573	3·2708	1·04569	·0436	·95630	73
18	·30901	·69098	3·2369	·32491	3·0776	1·05146	·0489	·95105	72
19	·32556	·67443	3·0715	·34432	2·9042	1·05762	·0544	·94551	71
20	·34202	·65797	2·9238	·36397	2·7474	1·06417	·0603	·93969	70
21	·35836	·64163	2·7904	·38386	2·6050	1·07114	·0664	·93358	69
22	·37460	·62539	2·6694	·40402	2·4750	1·07853	·0728	·92718	68
23	·39073	·60926	2·5593	·42447	2·3558	1·08636	·0794	·92050	67
24	·40673	·59326	2·4585	·44522	2·2460	1·09463	·0864	·91354	66
25	·42261	·57738	2·3662	·46630	2·1445	1·10337	·0936	·90630	65
26	·43837	·56163	2·2811	·48773	2·0503	1·11260	·1012	·89879	64
27	·45399	·54600	2·2026	·50952	1·9626	1·12232	·1089	·89100	63
28	·46947	·53052	2·1300	·53170	1·8807	1·13257	·1170	·88294	62
29	·48480	·51519	2·0626	·55439	1·8040	1·14335	·1253	·87461	61
30	·50000	·50000	2·0000	·57735	1·7320	1·15470	·1339	·86602	60
31	·51503	·48496	1·9416	·60086	1·6642	1·16663	·1428	·85716	59
32	·52991	·47008	1·8870	·62486	1·6003	1·17917	·1519	·84804	58
33	·54463	·45536	1·8360	·64940	1·5398	1·19236	·1613	·83867	57
34	·55919	·44080	1·7882	·67450	1·4825	1·20621	·1709	·82903	56
35	·57357	·42642	1·7434	·70020	1·4281	1·22077	·1808	·81915	55
36	·58778	·41221	1·7013	·72654	1·3763	1·23606	·1909	·80901	54
37	·60181	·39818	1·6616	·75355	1·3270	1·25213	·2013	·79863	53
38	·61566	·38433	1·6242	·78128	1·2799	1·26901	·2119	·78801	52
39	·62932	·37067	1·5890	·80978	1·2348	1·28675	·2228	·77714	51
40	·64278	·35721	1·5557	·83909	1·1917	1·30540	·2339	·76604	50
41	·65605	·34394	1·5242	·86928	1·1503	1·32501	·2452	·75470	49
42	·66913	·33086	1·4944	·90040	1·1106	1·34563	·2568	·74314	48
43	·68199	·31800	1·4662	·93251	1·0723	1·36732	·2686	·73135	47
44	·69465	·30534	1·4395	·96568	1·0355	1·39016	·2806	·71933	46
45	·70710	·29289	1·4142	1·00000	1·0000	1·41421	·2928	·70170	45
	Cosine.	Versed Sine.	Secant.	Cotangent.	Tangent.	Cosecant.	Coversed Sine	Sine.	Deg.

Table of Logarithms of Sines, &c.

Deg.	Sine.	Cosecant	Ver. Sin.	Tangent	Cotangent.	Covers. Sin.	Secant.	Cosine.	
0	Inf. Neg.	Infinity.	Inf. Neg.	Inf. Neg.	Infinity.	10·00000	10·00000	10·00000	90
1	8·24186	11·75814	6·18271	8·24192	11·75808	9·99235	10·00007	9·99994	89
2	8·54282	11·45718	6·78474	8·54308	11·45692	9·98457	10·00026	9·99978	88
3	8·71880	11·28120	7·13686	8·71939	11·28060	9·97665	10·00060	9·99940	87
4	8·84358	11·15642	7·38666	8·84464	11·15536	9·96859	10·00106	9·99894	86
5	8·94030	11·05970	7·58038	8·94195	11·05805	9·96039	10·00166	9·99834	85
6	9·01923	10·98077	7·73863	9·02162	10·97838	9·95205	10·00239	9·99761	84
7	9·08589	10·91411	7·87238	9·08914	10·91086	9·94355	10·00325	9·99675	88
8	9·14356	10·85644	7·98819	9·14780	10·85220	9·93491	10·00425	9·99575	82
9	9·19433	10·80567	8·09031	9·19971	10·80029	9·92611	10·00588	9·99462	81
10	9·23967	10·76033	8·18162	9·24632	10·75368	9·91716	10·00665	9·99335	80
11	9·28060	10·71940	8·26417	9·28865	10·71135	9·90805	10·00805	9·99195	79
12	9·31788	10·68212	8·33949	9·32747	10·67253	9·89877	10·00959	9·99040	78
13	9·35209	10·64791	8·40874	9·36336	10·63664	9·88932	10·01128	9·98872	77
14	9·38368	10·61632	8·47281	9·39677	10·60323	9·87971	10·01310	9·98690	76
15	9·41299	10·58700	8·53242	9·42805	10·57195	9·86992	10·01506	9·98495	75
16	9·44034	10·55966	8·58814	9·45750	10·54250	9·85995	10·01716	9·98284	74
17	9·46594	10·53406	8·64043	9·48534	10·51466	9·84980	10·01940	9·98060	78
18	9·48998	10·57002	8·68969	9·51178	10·48822	9·83946	10·02179	9·97821	72
19	9·51264	10·48736	8·73624	9·53697	10·46303	9·82893	10·02433	9·97567	71
20	9·53405	10·46955	8·78037	9·56107	10·43893	9·81821	10·02701	9·97299	70
21	9·55433	10·44567	8·82229	9·58418	10·41582	9·80728	10·02985	9·97015	69
22	9·57358	10·42642	8·86222	9·60641	10·39359	9·79615	10·03283	9·96717	68
23	9·59188	10·40812	8·90034	9·62785	10·37215	9·78480	10·03597	9·96403	67
24	9·60931	10·39069	8·93678	9·64858	10·35142	9·77324	10·03927	9·96078	66
25	9·62595	10·37405	8·97170	9·66867	10·33133	9·76146	10·04272	9·95728	65
26	9·64184	10·35816	9·00520	9·68818	10·31182	9·74944	10·04634	9·95366	64
27	9·65705	10·34295	9·03740	9·70717	10·29283	9·73720	10·05012	9·94988	63
28	9·67161	10·32839	9·06838	9·72567	10·27433	9·72470	10·05407	9·94593	62
29	9·68557	10·31443	9·09822	9·74375	10·25625	9·71196	10·05818	9·94182	61
30	9·69897	10·30103	9·12702	9·76144	10·23856	9·69897	10·06247	9·93753	60
31	9·71184	10·28816	9·15482	9·77877	10·22123	9·68570	10·06693	9·93307	59
32	9·72421	10·27579	9·18170	9·79579	10·20421	9·67217	10·07158	9·92842	58
33	9·73611	10·26389	9·20771	9·81252	10·18748	9·65835	10·07641	9·92359	57
34	9·74756	10·25244	9·23290	9·82899	10·17101	9·64424	10·08143	9·91857	56
35	9·75859	10·24141	9·25731	9·84523	10·15477	9·62984	10·08664	9·91336	55
36	9·76922	10·23078	9·28099	9·86126	10·13874	9·61512	10·09204	9·90796	54
37	9·77946	10·22054	9·30398	9·87711	10·12289	9·60008	10·09765	9·90235	53
38	9·78934	10·21066	9·32631	9·89281	10·10719	9·58471	10·10347	9·89653	52
39	9·79887	10·20113	9·34802	9·90837	10·09163	9·56899	10·10949	9·89050	51
40	9·80807	10·19193	9·36913	9·92381	10·07619	9·55292	10·11575	9·88425	50
41	9·81694	10·18306	9·38968	9·93916	10·06084	9·53648	10·12222	9·87778	49
42	9·82551	10·17449	9·40968	9·95444	10·04556	9·51965	10·12893	9·87107	48
43	9·83378	10·16622	9·42918	9·96966	10·03034	9·50242	10·13587	9·86418	47
44	9·84177	10·15823	9·44818	9·98484	10·01516	9·48478	10·14307	9·85698	46
45	9·84948	10·15051	9·46670	10·00000	10·00000	9·46670	10·15051	9·84948	45
	Cosine.	Secant.	Cov. Sin.	Cotangent.	Tangent	Ver. sin.	Coscecant.	Sinc.	Deg.

Fuller's Sliding Scale.

Arithmetical processes may be greatly facilitated by the use of sliding scales, but their employment had been practically limited to rough calculations by the inconvenient length necessary for working out results involving many figures. Professor George Fuller, M.I.C.E., has, however, by adopting the principle of a spiral scale, succeeded in producing an instrument which, though only 18 inches long, including the handle, has a scale nearly 42 feet in length. It consists of three concentric parts, two being hollow cylinders and the other a solid axis. The middle part, fixed to the handle which he calls the axis, though it would be better described as the body, is blank. The outer cylinder, 6 inches in length and 3 in diameter, freely movable in every direction on and around the body as an axis, carries a single logarithmic scale winding round it spirally from end to end, 41 ft. 8 in. in length. Of the 1000 primary divisions of the scale, the first 650 are subdivided into tenths, and the remainder into fifths, so that all figures to four places are either marked, or are midway between two marks, while through a great part of its length the eye can easily estimate lesser fractions of the sub-divisions. There is another scale around the upper or further end of this cylinder. The central axis or solid cylinder, sliding telescopically in the body or middle part, carries a straight rule, graduated at one side and ending in an index point, while from tho other side a fine index rod extends to a length of three inches, so that the distance between these two index points is the same as the axial length of the outer cylinder. A third index is attached to the handle parallel to the other, but in the opposite direction over the spiral scale of the outer cylinder.

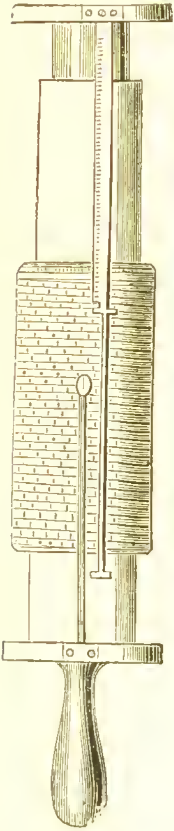


FIG. 8.

Fuller's slide rule is made by Mr. F. Stanley, of Great Turnstile, Holborn, W.C., price £3, with a pamphlet giving full instructions for its use.

Enough here to say that the rule enables one in a few moments to multiply or divide numbers of five figures, to work out problems in proportion, to obtain powers and extract roots to any degree, and in fact to do all that can be attained by the use of logarithms, or be wanted by the engineer or statistician.

II. METEOROLOGICAL PRACTICE.

The Barometer.

A "Standard" barometer, in which alone the level of the mercury in the cistern, *i. e.* the foot of the mercurial column, can be always made to coincide with the zero of the scale, and one in which the scale is marked on the tube or on a brass rod, not on or mounted on the wooden frame, should be hung perfectly perpendicularly in a place sheltered from sun and rain, but in a good light.

Reading and Correction.

To read the barometer.—First note the temperature, before the warmth of the observer's body can affect the thermometer. Then adjust the cistern by working the screw beneath it upwards or downwards until the point of the ivory peg meets its image on the surface of the mercury in the cistern, this point indicating the position of the zero whence the scale is graduated. Gently tap the barometer twice or thrice so as to overcome any adhesion of the mercury to the glass, and standing with the eye on a level with the upper end of the column, adjust the vernier so that its lower margin just shuts off the light above the summit of the curved surface of the mercury. If, as in Fig. 9, A, this correspond exactly with a line on the scale the observation is complete; if not, note the line on the scale next below, and then following the marks on the vernier upwards note the first which coincides with one on the scale. Each figure on the vernier represents $\frac{1}{100}$ = 0·01 inch, and each division $\frac{2}{1000}$ = $\frac{1}{500}$ = 0·002 inch, which together indicate the exact value of the excess of height over the next lower mark on the scale.

Thus in Fig. 9, B, the mercury stands a fraction above 29·650 inches on the scale, and the vernier having been adjusted, the line that coincides with one on the scale is the third above the figure 3, *i. e.* 0·036 is to be added to the 29·650, giving 29·686 as the correct reading. Sometimes two consecutive lines on the vernier may *appear* to coincide with two on the scale, the intermediate odd thousandth is then to be taken as the correct reading: thus in this case had the third and fourth lines *seemed* so to coincide with lines on the scale the reading would have been the mean of 29·686 and 29·688, *i. e.* 29·687. [The vernier being divided into 25 parts, together equal to 24 of the smallest divisions of the scale (viz. 0·05 inch), each of the former is less than one of the latter by $\frac{1}{25}$, *i.e.* by $\frac{1}{25} \times \frac{1}{20} = \frac{1}{500}$ = 0·002 inch.] The adjustment of the surface of the mercury in the cistern of Fortin's standard barometer to the zero of the scale is intended to obviate the "correction for capacity" otherwise necessitated by the fact that when the mercury rises in the tube it must sink in the cistern, and *vice versâ*, inversely as the diameters of the columns.

The Kew, or Adie's marine barometer achieves the same result by a scale empirically graduated to allow for the varying proportion between the mercury in the cistern and tube, but the impossibility of adapting a vernier to such a scale deprives it of the accuracy of the standard barometer, and the observations depend on the correct engraving of the scale.

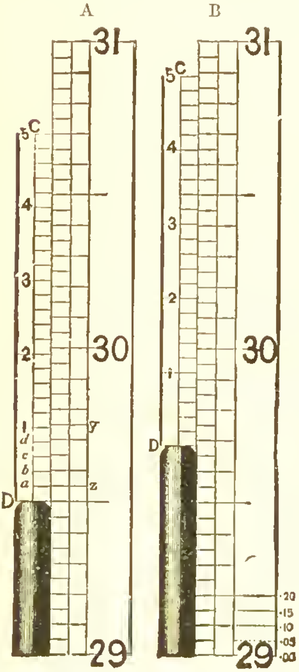


FIG. 9.

The syphon barometer is the simplest and in some respects the best, requiring no correction for capacity or for capillarity. While the mercury rises in one leg it sinks in the other, the zero is a point midway between the upper and lower ends of the instrument, and a scale and vernier are attached to each leg, those on the long or closed leg graduated upwards, and those on the short or open leg downwards from the common zero. The movement of the mercury is half what it would be in the ordinary form, and the real height of the column is the sum of the movements in each. Two readings have to be made and the results added together.

With the improvements of a capillary connection between the two legs, a lateral orifice instead of an open end to the shorter, and Brunton's pipette in the longer, to prevent the entrance of air into the vacuum, it is scarcely possible for it to get out of order.

Corrections.—The index error, if any, and the correction for capillarity, are marked for every half inch on Kew certificates. Correction for temperature, by which all readings are reduced to what they would be at 0° C. (32° F.), is calculated from the coefficients of expansion of mercury and of brass, the material of the scale, by Schuhmacher's formula.

The results, as applied to barometers with brass scales extending from the cistern to the top of the tube, are given in the table following for 27 and 30 inches and for every 10° F. Intermediate heights and temperatures may be found by proportional parts with approximate accuracy.

Temp.	27 in.	30 in.	Temp.	27 in.	30 in.	Temp.	27 in.	30 in.
0	+ ·069	+ ·077	40	− ·028	− ·031	80	− ·124	− ·138
28	+ ·001	+ ·001	50	− ·052	− ·058	90	− ·148	− ·164
29	− ·001	− ·001	60	− ·076	− ·085	100	− ·172	− ·191
30	− ·004	− ·004	70	− ·100	− ·111			

Correction for altitude.—The mercury falls approximately $\frac{1}{1000}$ inch = 0·001 inch for each foot above the sea level. But this varies a little with the temperature and humidity. The following table gives the *addition* in inches at 30 and 27 inch pressure and 0° 40° and 80° F. for 10, 100 and 1000 feet of altitude. Intermediate heights are calculated proportionately. The sea level at Liverpool mid-tide is the ordnance standard.

Height in feet.	Temperature of external air.		
	0° F.	40° F.	80° F.
When the	Barometer at	sea level reads	30 inches.
10	·012	·011	·010
100	·123	·112	·103
1000	1·208	1·105	1·017
When the	Barometer at	sea level reads	27 inches.
10	·011	·010	·009
100	·111	·101	·093
1000	1·087	·994	·915

Aneroid barometers are extremely sensitive and need no corrections, but must always be compared with a standard barometer for verification. They are very useful for estimating heights in surveying, &c., for which the difference between the readings in hundredths of an inch × 9 gives the difference of elevation in feet, since 0·1 inch corresponds approximately to 90 feet at ordinary temperatures.

THERMOMETERS.

The thermometers required are—

1. Shade maximum thermometer.
2. Shade minimum ,,
3. Solar radiation ,,
4. Terrestrial radiation ,,

Shade thermometers are best mounted in a hut of stout boards with a ridge roof, louvred sides, open below and raised on four posts 3 to 4 feet from the ground. The box should be at least 4 feet square, with a door on the side least exposed to the sun. It should be put up where it will be freely exposed to the movement of the air, but so far as possible sheltered from direct sunshine or radiation from a wall, *e.g.* on the north side of and at about 10 to 20 feet from the house.

They should all be self-registering, and it is well to have their bulbs carried beyond the frames.

The solar radiation thermometer has its bulb blackened, and it is enclosed in a glass cylinder from which the air has been exhausted. It should be fixed to a post about 4 feet above the ground, where it will be exposed to the full rays of the sun all day.

The terrestrial radiation or "grass minimum" should be mounted on a low tripod just above but not touching a grass plot, or if snow be on the ground, then in the snow. Scott recommends a black board in preference to the grass.

They should all read to tenths of a degree marked on the glass itself.

The shade temperature should be taken at least twice a day, 9 a.m. and 3 p.m.

The maximum and minimum thermometers are usually read early in the morning, and the maximum entered as reached on the previous afternoon. But it would be better to read them all morning and evening, since in winter the maximum temperature may occur in the morning and the minimum in the afternoon, being determined rather by the wind and clouds than by the hour of the day.

The mean of the maximum and minimum shade temperatures of each day does not truly represent the mean temperature. Herschell gives the following formulæ—

If observations are taken at 7 a.m., 2 p.m., and 9 p.m., or t, t′, and t″, then

$$\frac{t + t' + 2t''}{4} = \text{mean temperature of day.}$$

If at 8 a.m., 3 p.m., and 10 p.m.—

$$\frac{7t + 7t' + 10t''}{24} = \text{mean temperature of day.}$$

Comparison between Scales of Fahrenheit, Réaumur, and the Centigrade.

CENT.	FAH'T.	RMR.	CENT.	FAH'T.	RMR.
100°B.	212°B.	80°B.	55°	131°	44°
99	210·2	79·2	54	129·2	43·2
98	208·4	78·4	53	127·4	42·4
97	206·6	77·6	52	125·6	41·6
96	204·8	76·8	51	123·8	40·8
95	203	76	50	122	40
94	201·2	75·2	49	120·2	39·2
93	199·4	74·4	48	118·4	38·4
92	197·6	73·4	47	116·6	37·6
91	195·8	72·8	46	114·8	36·8
90	194	72	45	113	36
89	192·2	71·2	44	111·2	35·2
88	190·4	70·4	43	109·4	34·4
87	188·6	69·6	42	107·6	33·6
86	186·8	68·8	41	105·8	32·8
85	185	68	40	104	32
84	183·2	67·2	39	102·2	31·2
83	181·4	66·4	38	100·4	30·4
82	179·6	65·6	37	98·6	29·6
81	177·8	64·8	36	96·8	28·8
80	176	64	35	95	28
79	174·2	63	34	93·2	27·2
78	172·4	62·4	33	91·4	26·4
77	170·6	61·6	32	89·6	25·6
76	168·8	60·8	31	87·8	24·8
75	167	60	30	86	24
74	165·2	59·2	29	84·2	23·2
73	163·4	58·4	28	82·4	22·4
72	161·6	57·6	27	80·6	21·6
71	159·8	56·8	26	78·8	20·8
70	158	56	25	77	20·0
69	156·2	55·2	24	75·2	19·2
68	154·4	54·4	23	73·4	18·4
67	152·6	53·6	22	71·6	17·6
66	150·8	52·8	21	69·8	16·8
65	149	52	20	68	16
64	147·2	51·2	19	66·2	15·2
63	145·4	50·4	18	64·4	14·4
62	143·6	49·6	17	62·6	13·6
61	141·8	48·8	16	60·8	12·8
60	140	48	15	59	12
59	138·2	47·2	14	57·2	11·2
58	136·4	46·4	13	55·4	10·4
57	134·6	45·6	12	53·6	9·6
56	132·8	44·8	11	51·8	8·8

Comparison between Scales of Fahrenheit, Réaumur, and the Centigrade (continued).

CENT.	FAH'T.	RMR.	CENT.	FAH'T.	RMR.
10°	50°	8·0°	20°	4°	16°
9	48·2	7·2	21	5·8	16·8
8	46·4	6·4	22	7·6	17·6
7	44·6	5·6	23	9·3	18·4
6	42·8	4·8	24	11·2	19·2
5	41	4	25	13	20
4	39·2	3·2	26	14·8	20·8
3	37·4	2·4	27	16·6	21·6
2	35·6	1·6	28	18·4	22·4
1	33·8	0·8	29	20·2	23·2
Zero	32	Zero	30	22	24
1	30·2	0·8	31	23·8	24·8
2	28·4	1·6	32	25·6	25·6
3	26·6	2·4	33	27·4	26·4
4	24·8	3·2	34	29·2	27·2
5	23	4	35	31	28
6	21·2	4·8	36	32·8	28·8
7	19·4	5·6	37	34·6	29·6
8	17·6	6·4	38	36·4	30·4
9	15·8	7·2	39	38·2	31·2
10	14	8	40	40	32
11	12·2	8·8	41	41·8	32·8
12	10·4	9·6	42	43·6	33·6
13	8·6	10·4	43	45·4	34·4
14	6·8	11·2	44	47·2	35·2
15	5	12	45	49	36
16	3·2	12·8	46	50·8	36·8
17	1·4	13·6	47	52·6	37·6
18	—	14·4	48	54·4	38·4
19	2·2	15·2	49	56·2	39·2

Freezing point = 32° F. = 0° C. = 0° R. ; Boiling point = 212° F. = 100° C. = 80° R. To convert degrees Centigrade or Réaumur into degrees Fahrenheit, or *vice versâ*, use one of the following formulæ:

Let F. = Number of degrees Fahrenheit, C. = Number of degrees Centigrade, and R. = Number of degrees Réaumur, then :—

$$F = \frac{9\,C}{5} + 32 \qquad F = \frac{9\,R}{4} + 32 \qquad F = C + R + 32$$

$$C = \frac{5\,(F-32)}{9} \qquad R = \frac{4\,(F-32)}{9}$$

$$5R = 4C.$$

Hygrometry.

Cyclones and Anti-Cyclones.

All "weather," irrespective of climate, is primarily dependent on the differences of temperature and consequent movements of the air, caused by the sun's rays impinging at various angles on the earth's surface, and the further disturbance resulting from different amounts of absorption and radiation of heat, and of evaporation from land and water, as these are successively exposed to the sun by the rotation of the earth on its axis. The equilibrium of the atmosphere is constantly being disturbed and perpetually tending to restoration, the general effect being a tendency to vortical rotation of the air over limited areas, the vortices in these latitudes travelling from west to east. They are of two kinds, called respectively cyclones and anti-cyclones, the barometric pressure in the former being lowest in the centre, and rising rapidly outwards, while in the latter it is highest in the centre and falls very gradually towards the margin.

The wind produced by this difference of pressure gyrates in the anti-cyclone in the direction of the hands of a clock, in the cyclone in the reverse direction. Its force varies with the steepness of the "gradient," as the rise or fall of the pressure is called, and cyclonic areas are frequently spoken of as "depressions." The "veering" or change of wind through S'.E. and S'. to W. is the effect of a cyclone passing by to the north of the place of observation, and the wind "backs" or shifts in the reverse order when the centre of the cyclone passes by on the south.

The cyclone is marked by rapid movement, high winds and more or less cloud and rain, lowering the temperature in summer but making mild weather in winter. The anti-cyclone covers a wider area, moves very slowly, is attended by calm clear weather, therefore hot and dry in summer, but dry, cold and frosty in winter: often lasting from two to four or six weeks. There are, however, not unfrequently fogs along its outer border.

Humidity.

Humidity is absolute or relative, the former term expressing the actual weight of aqueous vapour present in a given volume of air, and the latter the proportion which it bears to the possible maximum at the temperature for the time being, and it is stated in degrees or percentages of the maximum, or saturation. Thus 4 grains of aqueous vapour in the cubic foot would represent saturation or 100 degrees of humidity at 50° F., but only 66 degrees at 62° F. and 50 at 70° F. If the temperature suddenly sank to 42° F., at which 3 grains constitute saturation, 1 grain would be deposited as dew. The point at which this deposition begins, in this case 49° F., is called the dew point. In other words, the dew point is the temperature at which the water actually present would amount to saturation; so that given the temperature at the time and the dew point, the actual weight of vapour present as well as the relative humidity can be calculated. The sensations of damp and dryness depend on the degree of saturation or relative humidity, and there may be far more aqueous vapour in the air on a hot dry day in summer than on a cold damp day in winter. Evaporation depends only indirectly on temperature, but directly on humidity, being most active when the air is relatively driest, and ceasing entirely when saturation is reached. It is not arrested even by freezing, taking place from the surface of ice no less than of water, if the air be, as it often is during prolonged frosts, relatively dry, while in hot but rainy weather it may be very small.

Humidity and evaporation are among the most important factors in the influence of climate and weather on health.

Wet and Dry Bulb Thermometers.

The only hygrometer in common use is the combination of the dry and wet bulb thermometers, the former giving the actual temperature and the latter that of evaporation, the dew point being calculated from the difference between their respective readings by means of a series of empirical factors worked out by Mr. Glaisher. The instrument is to be placed in the shade four feet above the ground, fully exposed to the air, but protected from radiant heat from walls, &c. The wet bulb is covered with muslin kept moist by twisting round it a skein of cotton, previously boiled in a solution of carbonate of soda and afterwards in ether to free it from fat, the other end of the cotton being immersed in a vessel of water. The cotton should be changed every fortnight and the water should be distilled or rain water. When the water is frozen and the syphon action arrested the muslin should be moistened with a sponge or brush and allowed to freeze again before the observation is taken, but should the temperature have risen above freezing point the muslin, &c. must be thawed with warm water, and the reading delayed till it has cooled down to the true temperature. When the air is saturated the readings of the two thermometers will be the same, and will be that of the dew point, otherwise that of the wet bulb is always lower, though above the dew point so long as the temperature of the air is above freezing. When this is lower and the wet bulb is, as it should be, cased in ice, it will read 32°, however low the dry one may have sunk.

The two tables following give (A) the weight of a cubic foot of vapour at each temperature, or the weight which constitutes saturation, the temperature being the dew point at 30° of barometric pressure, and (B) Glaisher's factors for all temperatures 0° to 100° F.

A.—*Table of Tensions and Dew-points, or Weight of Vapour constituting saturation at every degree from* 0 *F.°* *to* 100 *F.°*

Temp. F.°	Weight in grains of a cubic foot of Vapour.	Temp. F.°	Weight in grains of a cubic foot of Vapour.	Temp. F.°	Weight in grains of a cubic foot of Vapour.
0	0·55	34	2·30	68	7·51
1	0·57	35	2·39	69	7·76
2	0·59	36	2·48	70	8·01
3	0·62	37	2·57	71	8·27
4	0·65	38	2·66	72	8·54
5	0·68	39	2·76	73	8·82
6	0·71	40	2·86	74	9·10
7	0·74	41	2·97	75	9·39
8	0·77	42	3·08	76	9·69
9	0·80	43	3·20	77	9·99
10	0·84	44	3·32	78	10·31
11	0·88	45	3·44	79	10·64
12	0·92	46	3·56	80	10·98
13	0·96	47	3·69	81	11·32
14	1·00	48	3·82	82	11·67
15	1·04	49	3·96	83	12·03
16	1·09	50	4·10	84	12·40
17	1·14	51	4·24	85	12·78
18	1·19	52	4·39	86	13·17
19	1·24	53	4·55	87	13·57
20	1·30	54	4·71	88	13·98
21	1·36	55	4·87	89	14·41
22	1·42	56	5·04	90	14·85
23	1·48	57	5·21	91	15·29
24	1·54	58	5·39	92	15·74
25	1·61	59	5·58	93	16·21
26	1·68	60	5·77	94	16·69
27	1·75	61	5·97	95	17·18
28	1·82	62	6·17	96	17·68
29	1·89	63	6·38	97	18·20
30	1·97	64	6·59	98	18·73
31	2·05	65	6·81	99	19·28
32	2·13	66	7·04	100	19·84
33	2·21	67	7·27		

B.—*Glaisher's Factors.*

Reading of Dry Bulb F.°	Factor the product of which into the difference between the readings of the Dry and Wet bulb thermometer deducted from the former gives the Dew point.	F.°	Factor.	F.°	Factor.
		36	2·50	69	1·78
		37	2·42	70	1·77
		38	2·36	71	1·76
		39	2·32	72	1·75
		40	2·29	73	1·74
		41	2·26	74	1·73
		42	2·23	75	1·72
10	8·78	43	2·20	76	1·71
11	8·78	44	2·18	77	1·70
12	8·78	45	2·16	78	1·69
13	8·77	46	2·14	79	1·69
14	8·76	47	2·12	80	1·68
15	8·75	48	2·10	81	1·68
16	8·70	49	2·08	82	1·67
17	8·62	50	2·06	83	1·67
18	8·50	51	2·04	84	1·66
19	8·34	52	2·02	85	1·65
20	8·14	53	2·00	86	1·65
21	7·88	54	1·98	87	1·64
22	7·60	55	1·96	88	1·64
23	7·28	56	1·94	89	1·63
24	6·92	57	1·92	90	1·63
25	6·53	58	1·90	91	1·62
26	6·08	59	1·89	92	1·62
27	5·61	60	1·88	93	1·61
28	5·12	61	1·87	94	1·60
29	4·63	62	1·86	95	1·60
30	4·15	63	1·85	96	1·59
31	3·70	64	1·83	97	1·59
32	3·32	65	1·82	98	1·58
33	3·01	66	1·81	99	1·58
34	2·77	67	1·80	100	1·57
35	2·60	68	1·79		

Use of Glaisher's Tables.

Multiply the difference between the two readings by the factor (Table B.) opposite that of the dry bulb, and deduct the product from the latter ;—the remainder will give the dew point. Then finding (Table A.) the weight of vapour corresponding to the dew point, and therefore actually present, and that which at the actual temperature would constitute saturation, the proportion which the former bears to the latter will be the degree of humidity for the time being. Thus the dry bulb reading 67° F. and the wet 62° F. gives a difference of 5°. The factor opposite 67° is 1·8, which $\times\ 5 = 9$ and $67° - 9° = 58°$ = the dew point. The weight of vapour per cubic foot constituting saturation at 58° is 5·39 grains, and at 67° is 7·27 grains, therefore the present degree of humidity is $\frac{5{\cdot}39 \times 100}{7{\cdot}27} = 0{\cdot}74$ or 74 per cent. of saturation, or 74° of humidity.

Mr. Glaisher has also published a series of elaborate and accurate tables ; which, however, are too long for insertion here. Those given above are sufficient for all the purposes of the health officer.

Mr. Glaisher's work (published by Taylor and Francis, 2*s.* 6*d.*) contains, besides the General Tables referred to, and the shorter ones given here, a number of others, showing the methods by which he has arrived at these results. They demonstrate the expansion of dry air by heat, the elastic force of aqueous vapour in inches of mercury, the expansion of a volume of dry air when saturated with vapour, and the weights of a cubic foot of dry air, of vapour, and of saturated air, all calculated for a pressure of thirty inches of mercury, and for each degree Fahrenheit from 0° to 100°, together with empirical factors for correction of the results at great altitudes, obtained by observations made during his balloon ascents.

Lastly, full instructions for the use of the General Tables, and the additions and corrections to be made in the results under certain circumstances, as when the differences between the readings of the wet and dry bulbs are considerable.

The table on the next page, calculated by means of Glaisher's factors, gives the relative humidity or degree of saturation for each temperature from 32°—85° F., indicated by the difference in the readings of the dry and wet bulbs from 0°—15° F. with sufficient accuracy for all ordinary purposes.

Temperature indicated by the Dry Bulb	Difference between the dry and wet bulb.															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Relative humidity. Saturation = 100.															
85	100	95	90	85	80	76	73	68	64	61	58	55	52	49	46	43
84	100	95	90	85	80	76	73	68	64	60	57	54	51	48	45	43
83	100	95	90	85	80	76	73	68	64	60	57	54	51	48	45	42
82	100	95	90	85	80	76	73	68	64	60	57	54	51	48	45	42
81	100	95	90	85	80	76	72	68	64	60	56	53	51	47	44	41
80	100	95	90	85	80	75	72	67	63	59	56	53	50	47	44	41
79	100	95	90	85	80	75	72	67	63	59	56	53	50	47	44	41
78	100	94	89	84	79	75	72	67	63	59	56	53	50	47	44	41
77	100	94	89	84	79	75	72	67	63	59	56	53	50	47	44	41
76	100	94	89	84	79	75	71	67	63	59	55	52	49	46	43	40
75	100	94	89	84	79	74	71	66	62	58	55	52	49	46	43	40
74	100	94	89	84	79	74	71	66	62	58	55	52	48	45	43	40
73	100	94	89	84	79	74	70	66	62	58	54	51	48	45	42	40
72	100	94	89	84	79	74	70	65	61	57	54	51	48	45	42	39
71	100	94	88	83	78	73	70	65	61	57	53	50	47	44	41	38
70	100	94	88	83	78	73	69	65	61	57	53	50	47	44	41	38
69	100	94	88	83	78	73	69	64	60	56	53	50	47	44	41	38
68	100	94	88	83	78	73	69	64	60	56	52	49	46	43	40	37
67	100	94	88	83	78	73	69	64	60	56	52	49	46	43	40	37
66	100	94	88	83	78	73	69	64	60	56	52	48	45	42	40	37
65	100	94	88	83	78	73	68	63	59	55	51	48	45	42	39	36
64	100	94	88	82	77	72	68	63	59	55	51	48	44	42	39	36
63	100	94	88	82	77	72	68	63	59	55	51	47	44	41	38	35
62	100	94	88	82	77	72	68	62	58	55	50	47	44	41	38	35
61	100	94	88	82	77	72	67	62	58	54	50	47	44	41	38	35
60	100	94	88	82	76	71	67	62	58	54	50	46	43	40	37	34
59	100	94	88	82	76	71	67	61	57	53	49	46	43	40	37	34
58	100	93	87	81	76	71	66	61	57	53	49	45	43	40	37	34
57	100	93	87	81	75	70	66	61	57	53	49	45	42	39	36	33
56	100	93	87	81	75	70	66	60	56	52	48	44	41	38	35	32
55	100	93	87	81	75	70	65	60	56	52	48	44	41	38	35	32
54	100	93	86	80	74	69	64	59	55	51	47	43	40	37	34	31
53	100	93	86	80	74	69	64	59	55	51	47	43	39	36	33	30
52	100	93	86	80	74	69	64	59	54	50	46	42	39	36	33	30
51	100	93	86	80	74	68	63	58	54	50	46	42	38	35	32	29
50	100	93	86	80	74	68	63	58	54	49	45	41	37	34	31	29
49	100	93	86	79	73	67	62	57	53	49	45	41	37	34	31	28
48	100	93	86	79	73	67	62	57	52	48	44	40	36	33	30	
47	100	93	86	79	73	67	61	56	51	47	43	39	36	33	30	
46	100	93	86	79	73	67	61	56	51	47	43	39	35	32	29	
45	100	92	85	78	72	66	60	55	50	46	42	38	34	31	28	
44	100	92	85	78	71	65	59	54	49	45	41	37	34	31	28	
43	100	92	85	78	71	65	59	54	49	45	41	37	34	31	28	
42	100	92	85	78	71	64	58	54	49	44	40	36	33	30	27	
41	100	92	85	77	70	64	58	53	48	43	39	35	31	28		
40	100	92	85	77	69	63	57	52	47	42	38	35	31			
39	100	92	84	77	69	63	57	51	46	42	38	34				
38	100	91	83	75	68	62	56	50	45	41	37					
37	100	91	83	75	68	61	55	49	44	39						
36	100	91	82	74	67	59	53	47	42							
35	100	90	80	72												
34	100	89	79	72												
33	100	88	78	70												
32	100	87	75													

RAINFALL.

The Rainfall in England.

Order of months in the East of England.	Average rainfall in inches 1813 to 1872.			Order of months in the West of England
	England East.	London (slightly different).	England West.	
August	2·84	2·26	5·25	November
November	2·83	2·28	4·97	October
October	2·71	2·74	4·42	December
July	2·57	2·32	3·95	August
September	2·55	2·35	3·72	January
May	2·11	2·07	3·54	September
June	1·95	2·01	3·46	July
January	1·89	1·91	2·86	February
December	1·60	1·93	2·84	{March}
February	1·59	1·52	2·84	{June}
April	1·48	1·66	2·59	{April}
March	1·40	1·52	2·59	{May}
	25·52	24·55	43·03	

Rain Gauge.

The best form is that known as the Snowdon gauge, consisting of a glass funnel having a diameter of 8 inches, and therefore an area of 50 square inches, let into a cylindrical copper vessel, its tube dipping into a glass cylinder having a lip for convenience in emptying it. To retain snow, which might be blown out of the funnel before it had melted, a similar cylinder, though of course open below, is fixed on to the other, so as to form a rim or wall several inches high around the funnel which it must touch closely. The water or the melted snow is when collected, usually once a day, to be measured in an accurately graduated glass, or the receiver may be itself the measure. But the narrower the measuring glass the more accurate the estimation. Thus if the diameter of the measure be 2½ inches, its area will be 5 square inches, or one-tenth that of the funnel, and each inch and tenth inch will represent a depth of 0·1 and 0·01 inch of rain.

The gauge should be placed about a foot from the ground in an open situation free from all eddies, with no object subtending an angle of 20°. Theoretically the elevation should not make any difference, but in practice it is found that a gauge placed on a terrace or roof shows a less amount owing to the up-current of air produced by the deflection of the wind impinging on the face of the wall.

WIND.

Direction.

The vane must be put up where it will be unaffected by eddies, horizontal or vertical, and care be taken that it is adjusted to the true meridian, for the needle at the present time points west of the north, 19° in the S.E. of England and 25° in the N.W. of Ireland, the lines of equal declination running N.N.E. and S.S.W. It is sufficient to register the wind as N., N.E., E., S.E., S., S.W., W., and N.W., but any change during the day must be noted.

Pressure.

This important condition is determined by the anemometers of Osler or of Cator, in which a pencil records the pressure exerted by the wind on plates. Osler's is worked by springs, Cator's by levers, an objection to the former being that the springs are in time affected by exposure to the atmosphere. The indications, moreover, vary with the size of the plates, those having a surface of one square foot being usually employed.

Velocity.

Dr. Robinson's or Casella's Anemometers are most used. In Robinson's the wind is received on four cups which work a dial, the larger the cups the more correct the readings.

It was formerly the practice to assume that the register indicated one-third of the true velocity, but Prof. Stokes finds that with Robinson's anemometer, as used by the Meteorological Society, having cups 9 inches in diameter on arms 24 inches long, the factor must be 2·4. Sir F. James gives the formula $P = v^2 \times 0{\cdot}005$ for calculating the pressure from the velocity, v being the velocity in miles per hour, and P the pressure in lbs. per square foot, the pressure varying as the square of the velocity.

Beaufort's scale, adopted by the Meteorological Office, with the velocities indicated by each number, and Schott's corrected estimates, are shown in the table on next page.

Velocity of Wind, according to Beaufort and Schott.

Force.	Velocity in miles per hour.			
	Beaufort.		Schott.	
0	Calm	3	0	Very different.
1	Light air	8	1	
2	Light breeze	13	4	
3	Gentle ,,	18	10	
4	Moderate ,,	23	17	Approximately the same.
5	Fresh ,,	28	24	
6	Strong ,,	34	32	
7	Moderate gale	40	40	
8	Fresh ,,	48	48	
9	Strong ,,	56	56	
10	Whole ,,	65	67	
11	Storm	75	82	
12	Hurricane	90	100	

Weather Charts.

In the compilation of weather-maps the direction of the winds is indicated by arrows, and the force by the number of pinnæ from 1 to 5; thus, to take the table from the weather charts of the U.S.A. Signal Office :—

Symbol.	Force.	Velocity.	
		Miles per hour.	Metres per second.
/———>	1, 2	0 to 9·0	0 to 4·0
>———>	3, 4	9·1 to 22·5	4·1 to 10·0
>›———>	5, 6	22·6 to 40·5	10·1 to 18·0
>>———>	7, 8	40·6 to 67·5	18·1 to 30·0
>>>———>	9, 10	67·6 and upwards	30·1 and over

The table of velocities, pressure, and character given on the next page will be found probably more accurate and generally useful on land :—

Velocity and Pressure of Wind.

Miles per hour.	Feet per minute.	Feet per second.	Pressure (direct) in lbs. per square foot.	Description.
1	88	1·47	·005	Hardly perceptible.
2	176	2·93	·020	Just perceptible.
3	264	4·4	·044	
4	352	5·87	·079	Gentle breeze.
5	440	7·33	·123	
10	880	14·67	·492	Pleasant breeze.
15	1329	22·	1·107	
20	1760	29·3	1·968	Brisk gale.
25	2200	36·6	3·075	
30	2640	44·	4·428	High wind.
35	3080	51·3	6·027	
40	3520	58·6	7·872	Very high wind.
45	3960	66·	9·963	
50	4400	73·3	12·300	Storm
60	5280	88·	17·712	Great Storm.
70	6160	102·7	24·108	
80	7040	117·3	31·488	Hurricane.
100	8800	146·6	49·200	

The velocity of the wind shows a diurnal curve from a minimum in the two hours after midnight to a maximum in the two after noon, but this is an average subject to constant variation. Also a monthly variation or annual curve, highest between December and March, and lowest between May and October, the difference being far more marked in Scotland and Ireland than in England.

The representation of the mean velocities and directions of prevailing winds is very unsatisfactory. Wind roses are perhaps the best and simplest; the percentages of the observed directions being indicated by the relative length of the rays in a diagram of the compass, and the mean velocity or force (pressure) of each shown by a number at the extremity of the ray. The rays should be divided into ten equal segments by a series of concentric 5% circles, leaving the intermediate units only to be determined by measurement or by the eye. Thus supposing the results of two daily observations for a year to be as under, there would be shown as in the wind rose following—

	Obs.	per cent.
N.	90	12·0
N.E.	110	15·0
E.	140	19·1
S.E.	50	6·8
S.	80	11·9
S.W.	60	8·2
W.	110	15·
N.W.	90	12·
	730	100·0

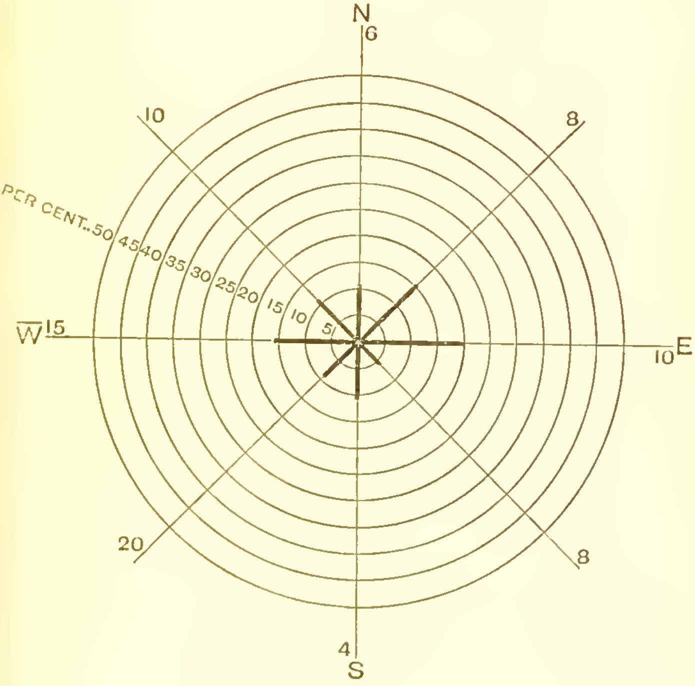


Fig. 10.

III. DEMOGRAPHY AND STATISTICS.

Population.

Estimated Populations.

Estimation of populations in the years intervening between the decennial census.

P = Population at present.
P' = Population at last census.
P'' = Population at preceding or penultimate census.
$$1 = \text{annual increase of population} = \frac{P' - P''}{10}$$
n = number of years since last census.
$\frac{1}{4}$ = addition for 3 months between date of census and the middle of the year.

$$P = P' + (n + \tfrac{1}{4})\left(\frac{P' - P''}{10}\right) = P' + 1\,(n + \tfrac{1}{4})$$

Ex.—Population in 1891 = 36,000, in 1881 = 32,000.

$$I = \frac{36{,}000 - 32{,}000}{10} = 400.$$

In middle of year 1885, $n = 4$
And $P = 36{,}000 + 400\,(4 + \frac{1}{4}) = 37{,}700$.

The true increase is, however, in geometrical not arithmetical progression, since the number of parents increases in an increasing population. The Registrar-General's method therefore substitutes the *rate* of increase for the annual increase assumed in the older method, and the same expressions and formulæ as are used in the calculation of compound interest, viz. r = annual rate of increase per unit; and $(1 + r)^n$ = the population at the end of the n^{th} year from the last enumeration.

Substituting R for $1 + r$

$$P = P'(1 + r)^n = P'R^n$$

To find value of r or R—

Taking the populations at the last census P' and at the preceding census P''

$P' = P''(1 + r)^n = P''R^n$, but $n = 10$

$\therefore P' = P''R^{10}$, and by logarithms, $\log. P' = \log. P'' + 10 \log. R$ and $10 \log. R = \log. P' - \log. P''$.

$\therefore \log. R = \frac{1}{10}(\log. P' - \log. P'')$ whence R is easily obtained from a table of logarithms.

Taking the same example in which $P'' = 32{,}000$, $P' = 36{,}000$ and P = present population four years since last census, or more correctly $4\frac{1}{4}$ years since that event $n = 4\frac{1}{4}$.

Hence log. $P' = \text{log. } 36{,}000 = 4{\cdot}556{,}303$, and log. $P'' = \text{log. } 32{,}000 = 4{\cdot}505{,}150$.

$\because$ Log. $P' - \text{log. } P'' = 0{\cdot}051{,}153$, and $\frac{1}{10}$ log. $P' - \text{log. } P'' = 0{\cdot}005{,}115$.

$(1 + r) = R = 1{\cdot}0118$ from the tables and $n = 4\frac{1}{4}$ years.

$\therefore$ In this case where P = present population to be estimated, $P' = 36{,}000$, $R = 1{\cdot}0118$ and $n = \frac{17}{4}$

$\therefore$ Log. $P = \text{log. } 36{,}000 + \frac{17}{4} \text{ log. } 1{\cdot}0118$.

But log. $1{\cdot}0118 = 0{\cdot}005{,}715$.

$\therefore$ $\frac{17}{4}$ log. $1{\cdot}0118 = 0{\cdot}021{,}739$ and log. $36{,}000 = 4{\cdot}556{,}303$.

$\therefore$ Log. $P = 4{\cdot}578{,}042$, and from the tables of logarithms $P = 37{,}848$, instead of 37,700, as by the other and older method.

Errors and Corrections.

Such estimates, proceeding on the assumption of a uniform increase in the population in successive decennia, are obviously conjectural and liable to error, since many circumstances may tend to accelerate or to retard the increase. Thus in 1881 the estimated populations of Paddington, Kensington, and Hampstead were respectively 123,677, 206,422, and 54,541, while the census showed the true populations to be in each case less, viz. 107,218, 163,151, and 45,452. The effect of these errors in the falsification of the death-rate is evident; thus in the case of Kensington the apparent death-rate of 15 per 1000 represented a true death-rate of 18·75. Still greater discrepancies have been revealed by the census of 1891. The population of London (Registrar-General's or the County of London) was estimated at 4,441,993, but found to be 4,221,452, or less by nearly a quarter of a million. Indeed the rate of increase in all of the 33 large towns had been much less in the last than in the preceding decennium, falling in Nottingham from 34·3 per cent. to 13·6, in Hull from 26·5 to 10·9, in Salford from 41·2 to 12·4, and in Liverpool from 12·0 to a decrease of 6·2. The calculated death-rates were therefore all too low, in the case of Salford as 3 : 4. !

Errors in the way of under-estimating the population lead to an exaggerated estimate of the death-rate. Thus twenty years ago Cambridge was considered an unhealthy town, until it was found at the census that its population had been under-estimated by 16 per cent., while that of Gosport, with an assumed death-rate lower than any town of its size, had been over-estimated by 33 per cent., and their respective death-rates differed by 0·2 per cent. only instead of by 12! In 1891, the population was found to have been over-estimated in 17, under-estimated in 5, and practically correct in 6 only of the 28 "great towns."

There are several devices more or less generally used for checking estimated populations, alike unauthorized and without official recognition, but useful if due regard be had to the character of the population. One is to ascertain from the last census the average number of persons to a house, and assuming the density to remain constant, to reckon the total population in any subsequent year from the number of inhabited houses, which can always be known from the rate-collectors' books. But the new houses may be of a different class from those which they have supplemented or superseded, with more or fewer occupants, while block-dwellings and large hotels introduce a serious disturbing element. A useful check is to be found in calculating the present population from the number of births in the year, on the assumption that the birth-rate remains the same as it was ascertained to be at the time of the last census; and since immigration exerts less influence on the constitution of a community than it does on its numbers, this method often gives a nearer approximation to the truth than those based on the annual rate of increase. Thus the population of Wandsworth having in 1861 been 70,403, and in 1871, 125,050, it was estimated in 1881 by the Registrar-General's method to be 221,093. But in 1872-81 the mean birth-rate had been 35·68 per 1000, and in 1881 the actual number of births was 7,582; therefore assuming these to represent a birth-rate of 35·68 per 1000, the population would have been $\frac{7582 \times 1000}{35 \cdot 68} = 212{,}500$. The census in April 1881 gave 210,434, and if to this we add for the quarter to the middle of the year one-fourth of the annual increase, or $\frac{8000}{4}$, the sum will be almost identical with this estimate, though less than that of the Registrar-General by 10,500. (*Vital Statistics*, Dr. Newsholme.)

Statistics of English Counties.

The entire population of England and Wales is here given for 1891 (29,001,018), with the gross estimated rental as settled by the Assessment Committees in the Valuation Lists, the amount collected for the Poor Rate for the year ending Lady-Day, 1890, and the number of paupers who were actually in receipt of relief on January 1st, 1891. The total number of persons in England and Wales receiving relief on January 1st, 1891, was 780,457 as against 793,246 on January 1st, 1890, a decrease of 12,789. The total cost for the year ended Lady-Day, 1890 (the last information published), was £8,434,345, as against £8,366,477 for the year ended Lady-Day, 1889, and £8,440,821 for the year ended Lady-Day, 1888. (For Wales see p. 46.)

The sum raised by Poor Rates during the year ended Lady-Day, 1890, was £15,820,594; the receipts in aid, inclusive of Treasury subventions, amounted to £1,968,616, forming a total receipt of £17,789,210. £8,557,199 of this amount was expended for other purposes than the relief of the Poor; the

COUNTIES.	Population.	No. of Acres.	Gross Rental.	Poor-Rate.	Paupers.
	1891.		£	£	1891.
Bedford	165,997	294,983	972,546	89,649	5,850
Berks	268,352	462,210	1,348,830	111,086	7,560
Bucks...............	164,325	477,151	1,026,010	81,883	5,870
Cambridge.........	196,266	524,935	1,361,541	112,709	7,249
Chester.............	707,962	657,123	4,222,481	295,525	14,803
Cornwall...........	318,601	863,665	1,481,052	156,255	11,171
Cumberland	266,550	970,161	1,866,052	128,536	6,888
Derby	432,414	658,624	2,277,685	183,505	9,515
Devon...............	636,184	1,655,208	3,657,368	323,523	24,763
Dorset	188,965	627,265	1,196,757	111,816	8,075
Durham	1,024,259	647,592	4,709,997	347,262	21,109
Essex	761,172	987,032	3,859,130	404,218	22,976
Gloucester.........	548,901	783,699	3,299,740	278,329	19,627
Hants...............	666,239	1,037,764	3,756,948	329,625	22,487
Hereford...........	113,391	532,918	949,931	99,962	4,736
Hertford...........	215,160	405,141	1,380,688	127,984	8,769
Huntingdon	50,290	229,515	402,675	30,385	1,414
Kent.................	806,287	974,671	5,204,822	497,438	21,852
Lancaster..........	3,957,954	1,208,154	22,060,687	1,595,491	72,143
Leicester...........	379,214	511,907	2,308,065	212,884	9,762
Lincoln.............	467,184	1,767,879	3,472,725	226,847	16,273
London.............	4,211,056	71,475	38,033,026	4,109,643	112,547
Middlesex	575,254	153,035	3,609,472	296,956	12,378
Monmouth........	275,086	370,350	1,328,217	139,815	8,561
Norfolk.............	448,609	1,356,173	2,622,456	261,703	20.208
Northampton....	308,149	629,912	1,852,955	151,531	8,122
Northumberland	506,096	1,290,312	2,921,527	209,275	10,286
Nottingham.......	505,154	527,752	2,834,523	156,194	12,191
Oxford..............	188,285	483,621	1,242,369	103,996	7,089
Rutland............	22,123	94,889	232,249	14,818	773
Salop................	254,745	844,565	2,009,368	124,051	5,227
Somerset...........	510,064	1,049,812	3,396,891	276,117	20,283
Stafford	1,103,322	748,433	5,083,712	386,102	34,543
Suffolk..............	365,479	944,060	1,927.759	162,470	13,675
Surrey	572,060	462,657	4,071,399	386,550	14,340
Sussex..............	554,538	933,269	3,969,003	285,984	10,126
Warwick...........	801,760	566,271	4,320,737	403,057	17,065
Westmorland.....	66,215	500,906	634,934	24,486	1,480
Wilts................	255,120	866,677	1,642,672	153,625	10,296
Worcester..........	422,515	472,453	2,257,888	104,270	12,721
York, E. Riding.	399,961	750,828	2,351,107	182,028	10,966
North Riding..	354,407	1,361,664	2,445,070	176,622	9,521
West Riding...	2,464,379	1,770,359	12,134,439	1,108,102	45,949
Total.........	27,499,984	32,527,070	179,700,566	15,052,307	730,246

payments towards the County, Borough, or Police Rate, for instance, amounted to £6,238,420; to Highway Boards, to £738,101; while the School-Boards received £790,713. Other payments are made out of the Poor Rate. The actual relief to the poor for the year ended Lady-Day, 1890, amounted to 5*s.* 9¾*d.* per head of the estimated population, while the sum levied as Poor Rate during the same period was equal to a rate of 10*s.* 10¾*d.* per head, being in the former case a decrease of ½*d.*, and in the latter an increase of 7*d.* as compared with the corresponding amounts in the previous year. This increase in the amounts levied as Poor Rates is to be accounted for by the fact that the expenses incurred by the London County Council are placed on the Poor Rate, whereas those of the late Metropolitan Board of Works were defrayed from other sources.

Population of Counties.—The county population is that given in the preliminary Report of the Census of 1891, as the population of each Registration County. The Registration Counties do not precisely correspond with the areas of ordinary counties, but with Poor Law areas to which the figures in this table relate. In 1860 the amount levied for Poor Rates was at the rate of 7*s.* 10*d.* per head ; in 1890 the amount levied was at the rate of 10*s.* 10¾*d.* In 1860 the officials employed received but £644,799; in 1890 this had increased to £1,394,687.

COUNTIES.	Population.	No. of Acres.	Gross Rental.	Poor-Rate.	Paupers.
	1891.		£	£	1891.
Anglesey..........	34,210	193,511	145,542	19,398	1,895
Brecon.............	52,864	460,158	331,535	34,682	1,626
Cardigan...........	86,349	443,387	367,731	52,076	3,221
Carmarthen.......	118,632	594,405	571,946	59,045	4,514
Carnarvon.........	125,596	369,477	596,275	67,047	5,971
Denbigh............	116,688	425,038	649,376	58,016	3,696
Flint.................	42,565	161,807	216,232	25,148	2,126
Glamorgan.........	693,001	516,959	3,233,346	312,605	17,158
Merioneth	64,725	384,717	335,076	40,965	2,947
Montgomery......	67,290	495,089	470,342	39,394	2,777
Pembroke	1,995	391,181	425,867	47,847	3,574
Radnor.............	17,119	276,552	119,815	12,064	706
Total.........	1,501,034	4,712,281	£7,463,083	£768,287	50,211

LONDON WITHIN VARIOUS BOUNDARIES.	AREA IN STATUTE ACRES.	POPULATION, 1891.
Within the Registrar-General's Tables of Mortality ...	74,692	4,211,056
County of London and School Board District ...	75,462	4,231,431
City within the Municipal and Parliamentary Limits	668	37,694
Metropolitan Police District (not including City) ...	440,891	5,595,638

SCOTLAND.

County.	Population, 1891.	Acres Cultivated.	Valuation, 1891.	Registered Paupers and Dependents.
Aberdeen	281,331	573,189	£1,453,175	6,557
Argyll	75,945	120,522	505,362	2,418
Ayr	224,222	293,859	1,322,865	5,113
Banff	64,167	157,353	251,263	1,861
Berwick	32,398	181,211	332,281	753
Bute	18,408	22 966	124,592	330
Caithness	37,161	100,853	163,192	1,706
Clackmannan ..	28,433	14,562	165,995	413
Dumbarton ..	94,511	41,877	548,790	1,495
Dumfries	74,308	213,784	617,946	1,732
Edinburgh	444,055	127,669	3,198,972	7,962
Elgin or Moray ..	43,418	104,149	238,775	1,608
Fife	187,320	229,752	1,057,304	3,428
Forfar	277,788	235,613	1,500,497	5,180
Haddington ..	37,491	107,420	311,075	954
Inverness	88,362	111,986	427,229	3,553
Kincardine ..	36,647	116,912	270,185	617
Kinross	6 289	33,874	55,987	140
Kirkcudbright ..	39,979	164,221	361,550	1,058
Lanark	1,045,787	227,218	6,062,258	20,209
Linlithgow.. ..	52,789	53,612	334,436	977
Nairn	10,019	24,494	46,605	293
Orkney and Shetland ..	59,149	84,328 51,884	77,759	843
Peebles	14,760	37,053	143,095	222
Perth	126,128	333,845	1,106,463	2,917
Renfrew	290,790	90,224	1,316,187	4,404
Ross and Cromarty	77,751	122,248	306,846	3,517
Roxburgh	53,726	174,199	472,508	942
Selkirk	27,349	20,308	113,240	237
Stirling	125,601	104,228	655,331	2,310
Sutherland.. ..	21,940	23,126	95,729	899
Wigtown	36,048	133,598	237,290	1,071
Zetland			46,500	1,116
Total, Scotland..	4,033,103	4,438,137	23,924,882	86,835

IRELAND.

Provinces and Counties.	Population, 1891.	Extent in Acres, 1881.	Valuation of Houses and Land, 1891.	Persons in receipt of Poor Relief on 3 Jan., '91.
Leinster.				
Carlow	40,936	221,295	£164,855	1,213
Dublin	429,111	226,895	1,187,176	9,680
Kildare	69,088	418,496	338,710	2,330
Kilkenny	87,154	507,254	359,421	3,184
King's	65,563	493,263	243,665	1,675
Longford	52,647	257,222	153,289	1,748
Louth	70,852	201,618	233,748	2,836
Meath	76,616	578,298	547,515	3,068
Queen's	64,639	424,853	259,902	1,477
Westmeath ..	65,028	434,017	316,706	2,149
Wexford	111,536	573,200	376,722	4,028
Wicklow	61,934	499,822	274,291	2,010
Ulster.				
Antrim	427,968	711,276	1,277,881	6,306
Armagh	143,056	313,036	423,889	801
Cavan	111,679	467,025	274,726	1,558
Donegal	185,211	1,190.269	297,189	1,257
Down	266,893	611,926	865,051	
Fermanagh ..	74,037	417,665	236,856	504
Londonderry ..	151,666	513,388	389,499	1,040
Monaghan	86,089	318,806	265,035	749
Tyrone	171,278	778,943	438,465	1,486
Munster.				
Clare..	123,859	768,265	317,016	4,041
Cork	436,641	1,838,921	1,235,985	16,840
Kerry	178,919	1,159,356	290,393	4,659
Limerick	158,563	662,972	532,285	7,411
Tipperary	172,882	1,048,969	680,084	6,468
Waterford	98,130	456,198	317,479	3,697
Connaught.				
Galway	214,256	1,502,362	474,923	4,178
Leitrim	78,379	376,510	136,622	1,238
Mayo	218,406	1,318,130	314,770	3,467
Roscommon ..	114,194	585,407	295,576	2,186
Sligo	98,338	451,815	213,870	1,412
Total, Ireland ..	4,706,448	20,327,472	14,033,594	107,129

33 Towns.	Population estimated to middle of 1898.	Comparative mortality figure 1898.	Recorded Death-rate 1898.	Corrected Death-rate 1898.	Standard Death-rate 1898.	Factor for Correction, 1891.	Birth-rate 1898.	Deaths of Infants to 1000 Births.	
								1898.	1888–97.
Croydon	124,421	824	13·89	14·48	18·37	1·0424	25·4	150	128
Cardiff	177,770	941	14·82	16·54	17·16	1·1159	31·1	158	160
West Ham ...	286,654	945	15·41	16·62	17·75	1·0788	30·6	170	154
Portsmouth ...	186,618	948	16·30	16·67	18·73	1·0224	26·7	156	150
Brighton ...	122,310	973	16·91	17·10	18·94	1·0110	24·8	181	148
Bristol	316,900	1,015	17·20	17·85	18·33	1·0379	28·6	164	144
Norwich	111,699	1,033	18·96	18·16	19·99	0·9579	29·9	192	175
Leicester	208,662	1,046	16·93	18·38	17·64	1·0855	29·6	191	199
Huddersfield ...	102,454	1,053	15·92	18·51	16·47	1·1627	22·5	153	158
Derby	104,384	1,055	16·82	18·55	17·36	1·1031	27·4	169	152
Burnley	109,546	1,065	16·30	18·72	16·67	1·1487	27·1	195	209
Plymouth ...	99,136	1,080	19·54	18·99	19·70	0·9720	29·7	170	168
Nottingham ...	236,137	1,081	17·67	19·00	17·81	1·0752	28·9	178	174
Birkenhead ...	113,189	1,090	17·44	19·17	17·42	1·0993	30·4	186	162
Hull	229,887	1,097	18·36	19·29	18·23	1·0504	33·4	182	173
Halifax	96,729	1,131	17·87	19·89	17·20	1·1133	22·9	163	158

London	**4,504,766**	**1,133**	**18·68**	**19·91**	**17·97**	**1·0656**	**29·5**	**167**	**155**
Oldham	148,288	1,145	17·58	20·13	16·72	1·1453	25·3	175	178
Bradford	233,737	1,146	17·60	20·14	16·73	1·1446	24·0	185	171
Swansea	102,001	1,154	18·57	20·29	17·53	1·0924	28·9	184	157
Blackburn ...	133,228	1,179	18·45	20·72	17·05	1·1231	27·1	206	201
Preston	116,356	1,210	19·35	21·27	17·42	1·1993	31·0	225	234
Leeds	416,618	1,211	19·21	21·29	17·28	1·1082	31·2	182	178
Bolton	122,495	1,249	19·38	21·96	16·90	1·1331	30·9	168	179
Birmingham ...	510,343	1,257	20·00	22·10	17·33	1·1050	34·0	191	180
Gateshead ...	103,775	1,259	20·61	22·14	17·83	1·0740	35·5	208	166
Wolverhampton	88,051	1,266	21·27	22·26	18·30	1·0464	35·8	200	188
Sheffield	356,478	1,280	20·24	22·51	17·22	1·1120	33·9	195	180
Newcastle ...	223,021	1,327	21·42	23·53	17·58	1·0892	31·7	190	167
Sunderland ...	143,849	1,351	22·63	23·75	18·25	1·0493	35·4	202	169
Manchester ...	539,078	1,411	21·89	24·80	16·90	1·1331	32·7	197	185
Salford	215,702	1,452	22·70	25·52	17·03	1·1244	34·7	212	198
Liverpool ...	633,645	1,498	23·98	26·33	17·44	1·0980	35·2	184	189
Mean of 33 Towns ...	11,218,378	1,171	19·03	20·58	17·71	1·0813 *0·9845	30·3	178	167

* England and Wales, less 33 towns.

Migratory Populations.

In watering-places and health resorts a great difficulty is felt in forming a correct, that is to say a fair estimate of the population. During the "season" the visitors may constitute a considerable addition to the population, and the date of the census may correspond with the fullest or the emptiest month. The resident population may be 10,000, and the visitors at one time be 5000. Which population, 10,000 or 15,000, is to be the basis? To exclude the death of visitors while including them wholly or partly in the living population would give too favourable an estimate. If it were possible they should be referred to the death registers of the towns whence they came, and which otherwise benefit by their dying away from home. It would be well to determine if possible the mean of the monthly population; but the visitors may consist mainly of healthy pleasure-seekers or of invalids. Some common rule of practice is much to be desired.

The number of domestic servants in a community introduces a fallacy, since they never die in service, nor for the most part in the towns where they were reckoned among the living, being largely recruited from rural districts to which they return when seriously ill, unduly raising the death-rate in the latter, as they had made it appear too favourable in the towns where they lived.

DEFINITION OF TERMS USED IN VITAL STATISTICS.

$$\text{Mean age of the living} = \frac{\text{Sum of ages at census}}{\text{Number of persons living}}$$

$$\text{Mean age at death} = \frac{\text{Sum of ages at death}}{\text{Number of deaths}}$$

$$\text{Mean duration of life} = \frac{\text{Number of population}}{\text{Number of deaths in a year}}$$

Probable duration of life = Period in which any sufficient number, as a million born, is reduced to one-half.

This, which is also called the expectation of life at birth, is not the same with the mean age at death, for in two communities 1 in 40, *i.e.* 25 per 1000, may die annually: but in one the deaths may be mostly those of infants, the survivors reaching a good old age; in the other few may attain a great age, though the infant and child mortality may be low. Natural increase = excess of births over deaths—in 1881–91 = 13·97 % for the ten years, but reduced by excess of emigration over immigration to 11·66 % for England and Wales.

The rule given for finding the mean duration of life applies only to a stationary population, *i. e.* one in which the births only equal the deaths, a condition rarely met with.

Birth, Death, and Marriage Rates.

Birth Rates.

There is a degree of correspondence between the birth and marriage rates which is not so easily explained as would at first sight appear. Most probably the fluctuations in the birth-rate are largely connected with the excess or deficiency of first-born children, and while as a rule every married woman between the ages of 20 and 40 years bears a child in each three years, the first year is in the great majority of cases attended with childbirth, various causes, natural, morbid, social, and artificial, coming into play later; so that while one in three married women, two in three, or three in four, brides, are mothers in every year.

The birth-rate in England has during the last 50 years averaged 33·8 per 1000, the maximum of 36·5 having been reached in 1876, and the curve beginning and ending with the minimum of 30 to 31. But births should not be calculated on the total population when one is comparing one community with another, unless they be reduced to a normal standard of constitution as regards sex, age, and marriage. For such comparisons the birth-rate should be calculated on (1) the number of women, or (2) of married women, between the ages of 15 and 50 (55 Farr), or, (3) better still, on those between 20 and 40 years who constitute the overwhelming majority of active mothers.

The illegitimate births in like manner may be calculated (1) on the legitimate, or, (2) on the unmarried women of childbearing age, and the subdivision of this into two periods is still more necessary, kept women, the victims of seduction and those of loose morals being for the most part young, and many of such mothers being married subsequently. The illegitimate birth-rate has steadily fallen from a mean of 2·25 to 1·4 per 1000 population; but the rate, especially when tested by the composition of the female population of productive age, is found to vary greatly in different districts in a way not easy to explain—London and the counties south of the Thames standing best, *i. e.* lowest, and the remote agricultural counties of Cumberland and Norfolk worst; the manufacturing being above the mean, and the mining counties still more so.

The higher rate of mortality among illegitimate children is not due to anything inherent in the circumstances of their birth, but to the neglect to which they are subsequently subjected from the shame attaching thereto; for in some of the Spanish colonies, where half the population is born out of wedlock, no such difference is observed. In more "moral" communities these unhappy infants fall into the hands of the "baby-farmer."

In France the production of children is deliberately restricted to the possible provision for them at home, and for the most part on the soil. In Great Britain a free margin is allowed for development of manufactures, and emigration. It is this relative license that has rendered possible the colonial empire and extension of the British races over the world, but that a natural law is in action, sufficient to maintain the equilibrium between population and means of subsistence, voluntarily though unconsciously brought to bear on society, is evident when one reflects that the single but marriageable women between 15 and 35 years of age are more than half again as numerous as the married, and that by drawing on this reserve of productive power, the birth-rate might be raised 20, 50, or even 100 per cent.

The same result, though to a less extent, would follow the earlier marriage of girls by two or three years, and the opposite or lowering of the birth-rate by delaying it for a like period.

Indeed such phenomena may be observed, and the attention of all economists and philanthropic men called thereto, during the rise of industries and fluctuations of trade. It is often said that a high birth-rate involves a high death-rate, the latter constituting a sort of natural check on the former. Of course the mortality in infancy being unavoidably high the actual number of deaths will be increased, but the majority of children survive to swell the ranks of young people who have the lowest mortality ; so that if the high birth-rate be the natural and direct result of prosperity and high wages, as in industries employing adult men only, and in flourishing colonies, the birth-rate will greatly exceed the death-rate, and every year the disparity will be more marked.

Marriage Rate.

The number of persons married to 1000 living has averaged 16·14 during the last 50 years ; the maxima of 18 or 17·5 having been reached in 1845, 50–52, 65–66, and 72, 73. It has now for several years been at its lowest level of 14 or a little over. The curves follow very closely the fluctuations of trade, in other words, young men marry so soon as good employment offers.

The mean age of men at marriage is 26, of women, 24. Of men about 7 per cent., of women 21 per cent., marry under 21, but these figures are not trustworthy, since among the improvident poor in London, numbers of young persons overstate their age, with the connivance of their parents.

The number of children to each marriage is about 4½ ; whether early marriages would *per se* increase the number of births or not is a disputed question, *i.e.* whether women marrying at 18 years would have more than those marrying at 27. But they would increase the total births and population by the mere fact of shortening each generation, even though the several unions were not more prolific. The number of children to each woman in wedlock is a more accurate index of the fecundity of the females of any particular race or class than those to each marriage, for the re-marriage of a widow simply prolongs her child-bearing activity just as if her first husband had survived. This does not begin again *de novo*, but had been prematurely arrested. More women marry than men, for re-marriages of widowers are more frequent by half than those of widows, and widowers more often marry spinsters than widows marry bachelors.

The influence for good and for evil on the moral and social conditions of a population of a large proportion of early marriages, especially of men, is a complex but serious question. It must, however, be remembered that a *skilled* artisan is, unlike a professional or commercial man, in a position to earn a full income at an age little above 20, and his power of earning does not increase with age, but rather the reverse. It may be objected that these reflections are out of place in a Health Officer's Pocket-book, but I maintain that the medical officer who simply reproduces the Registrar's report without note or comment fails entirely in his duty; and that having all the facts, together with the power of deducing from them the truths they are capable of teaching as to the material, social, and moral conditions of the community over whose welfare he presides, he is bound to avail himself of these opportunities to the utmost, and to insist on their lessons in every report.

Death Rates.—Method of Calculating.

Death-rates are usually reckoned per 1000 of the population, but in calculating those from particular diseases in which there would thus be several decimal places, rates per 10,000 or 100,000 are sometimes employed.

The death-rate is obtained by multiplying the actual number of deaths into 1000, &c., and dividing the product by the number of the population. Thus if in a town having 120,000 inhabitants there were 2400 deaths in the year,

$$\frac{2400 \times 1000}{120,000} = 20 \text{ per } 1000.$$

The death-rate and the number of persons living of whom one dies are convertible thus, $\frac{1000}{50} = 20$ and $\frac{1000}{20} = 50$, *i. e.* with a death-rate of 20 per 1000, one person in 50 dies annually.

The so-called "death-rates for the week" published by the Registrar General are not strictly death-rates, and though of a certain value for some purposes, are no indications of the relative health of different towns, being greatly dependent on weather and on epidemics of a transient character and other causes. They mean that if the actual rate of mortality were to be maintained throughout the year the annual death-rate would be so much.

Since there are 52·17747 weeks in the year the estimated population is divided by that number, and the quotient is called the "weekly population," on which the death-rate is calculated. Thus if the population be 143,956, the "weekly population" is $\frac{143,950}{52{\cdot}17747} = 2758$, and if the deaths in any week be 35, the annual death-rate for that week is obtained thus—

$$\frac{35 \times 1000}{2758} = 12{\cdot}69$$

The "quarterly death-rate" is calculated by multiplying the weekly population into 13·, and taking the deaths of the thirteen weeks wholly or most nearly comprised in the quarter in question.

Combined Death Rates.

In determining the mean death-rate of two populations or groups of persons, the proportion which the two bear one to the other must be taken into account, for the mean of the two death-rates will be the mean death-rate only when the two populations are equal. Yet this is one of the commonest statistical errors. Thus the population of

Battersea was 125,090, and its death-rate 20·00
Putney ,, 14,450, ,, ,, 13·70

but the mean death-rate was not $\frac{33{,}7}{2} = 16{\cdot}85$,

for the one population was eight times as numerous as the other, and the influence of the low death-rate of Putney would be over-estimated to that extent.

The proper method would be

Battersea, population	125,090, deaths	2503
Putney, population	14,450, deaths	196
	139,540	2702

Therefore $\frac{2702 \times 1000}{139,540} = 19{\cdot}59$, the true death-rate.

The mathematical demonstration and general formula for such cases is—Let a and b be the two groups, and $a + b =$ the total population. $x =$ the death-rate for a; $y =$ death-rate for b.

The number of deaths in $a = a \times x = ax$

,, ,, ,, ,, $b = b \times y = by$

and the total number of deaths in $(a + b) = ax + by$, and the death-rate per unit for the whole $(a + b) = \frac{ax + by}{a + b}$. If $a = b$, then the general death-rate $= \frac{x + y}{2}$; but if not, suppose, *e.g.* $a = 2b$, then it $= \frac{2x + y}{3}$ and so on.

When the values of a, b, and the death-rate of $(a + b)$ and of a viz. x are known, that of b viz. y can be calculated from the same formula.

$$\text{Death-rate of } (a + b) = \frac{ax + by}{a + b}$$

Local Death Rates.

In all large towns, *i. e.* with populations of a quarter of a million and upwards, and even in those with 100,000, if the conditions of different districts are very different, such separate calculations should be made, if the real state of the poorer and insanitary quarters would be duly appreciated. Thus Dr. Poore, while admitting that the death-rates of 1861-70, 1871-80, and 1881-90 of 24·4, 22·5, and 20·0 are apparently encouraging, asks whether the "London" of 1890 is strictly comparable to that of 1860, the population having not merely increased from 2,800,000 to 4,400,000, but 1,700,000 of these having settled in newly built outlying districts. Twelve of the older central districts having an aggregate population of 622,000, show a general death-rate of 27·7, the constituents of which range from 24·8 in Shoreditch and St. Lukes to 32·4 in Holborn, and 34·6 in St. George's in the East. Unless we take into consideration such local death-rates as 28, 32, and 34, the general death-rate of 20 is fallacious and delusive. The like analysis of the populations of the several areas comprised in the municipalities of Birmingham, Liverpool, &c., would reveal local death-rates of appalling magnitude.

The Normal Constitution of the Population of England and Wales in 1881 *was*—

	All Ages.	0–5	5–10	10–15	15–20	20–25	25–35	35–45	45–55	55–65	65–75	75 &c.
Both Sexes.	1000	136	121	108	98	98	146	113	84	59	33	13
Males.	486	69	60	54	49	43	71	54	40	28	15	6
Females.	514	67	61	54	49	46	75	59	44	31	18	7

Normal Death-rate at each Age.

Mean annual death-rate of each age per 1000 living.	Males.	68·14	6·67	3·69	5·23	7·32	9·30	13·74	20·5	34·76	69·57	169·08
	Females.	58·10	6·20	3·70	5·43	6·78	8·58	11·58	15·59	28·54	60·82	155·83
	Ages.	0–5	5–10	10–15	15–20	20–25	25–35	35–45	45–55	55–65	65–75	75 &c.

For the practical use of these tables, see p. 57. It is possible that, all other conditions and the mortality at each age being the same in two towns, the mere fact of one having half again as many children under five years as the other might make a difference of 4·5 per 1000 in the death-rate.

Population estimated or enumerated and recorded. Birth and Death-rates for recent years of certain Scottish, Irish, Continental, Colonial, and American cities.

	Population.	Birth-rate.	Death-rate.		Population.	Birth-rate.	Death-rate.
Edinburgh ...	295,628	27·5	19·7	Lille	200,325	31·8	23·5
Glasgow ...	724,349	33·6	21·2	Brussels ...	551,011	24·5	16·8
Dublin	349,594	31·2	26·8	Rome	499,861	22·4	17·9
Belfast	304,610	36·9	25·5	Turin	344,203	20·9	19·6
Berlin	1,773,003	26·7	17·3	Florence ...	199,080	23·6	21·9
Hamburg ...	661,015	32·1	17·9	Venice	169,545	23·2	22·6
Dresden ...	397,300	33·1	19·1	Trieste	165,177	31·3	28·2
Frankfurt-A-M. ...	229,279	30·1	16·5	Vienna	1,590,295	30·2	20·1
Breslau	392,795	35·4	24·8	Prague	382,029	28·0	23·8
Munich	430,000	36·4	25·1	Buda Pesth ...	648,104	35·4	22·1
Amsterdam ...	503,319	29·6	17·1	St. Petersburg	1,132,677	28·5	25·8
Rotterdam ...	303,878	36·2	18·6	Sydney	432,625	28·3	12·7
Copenhagen ...	345,000	29·7	17·9	Melbourne ...	475,380	26·2	15·4
Stockholm ...	283,550	26·2	17·3	Toronto	181,220	22·5	15·8
Christiania ...	221,255	33·6	16·8	Montreal ...	216,650	34·4	33·7
Paris	2,511,629	23·6	19·7	Quebec	63,090	34·8	24·4
Lyons	438,077	19·2	20·4				
New York ...	3,550,058	?	18·4	Philadelphia...	1,266,832	?	18·8
Boston	547,263	29·3	20·1	St. Louis ...	623,000	19·1	14·3
Cincinnati ...	405,000	16·3	14·8	San Francisco	360,000	14·2	19·4

The age and sex constitution of such populations as San Francisco and other rapidly growing towns are, however, so abnormal as to render comparisons useless.

Constitution of a Population.

By this is meant the proportions in which (1) males and females, and persons of different ages, and (2) of different social positions and industrial pursuits enter into the composition of the community.

No conclusions of any value can be deduced from a bare comparison between the death-rates of two populations very differently constituted.

This is so obvious a truth that it should seem superfluous to insist on it, were it not that wherever the belief in the healthiness of a place is essential to its prosperity, and the crude or actual death-rate appears lower than that of rival towns of the general population, or even of towns far less favourably circumstanced, there is a strong temptation, rarely resisted, to accept the apparent conclusion without qualification or correction.

To obtain the corrected death-rate for any town or district—

The numbers of males and of females at each age-period being known from the last census, and the mean annual death-rate for each age and sex given by the Registrar General, calculate the number of deaths which should take place in each class, if the local death-rates were the same as those for the whole country.

The sum of the calculated deaths for all ages gives the standard death-rate as the actual number gives the recorded rate, and dividing the mean death-rate for the whole country by the standard death-rate for the local population, we obtain the factor for correcting the recorded rate.

It is well to take the fives rather than the even tens, since many persons a little above or below the latter return their ages at the census or are reported at death by their friends as 40, 50, &c.

In most urban populations the proportion of persons of the ages of low mortality is excessive (Norwich and Plymouth being the only exceptions among the great towns), and consequently the recorded death-rate gives too favourable a view of the local health; while in rural populations the reverse conditions usually prevail.

Factor for correction for Age and Sex.

The correction of the death-rate of the "33 great towns" of England and Wales according to age constitution was first made by the Registrar-General in 1883, and will be repeated after each census. This is done by multiplying the recorded death-rate into a factor provided by the Registrar-General, the product or "corrected death-rate" showing the mortality in its true character. He gives at the same time the "standard death-rate," or that which should be found were the mortality at each of twelve age-periods the same as in the entire nation, and the "comparative mortality figure," taking that of the country at large as 1000.

To put the matter more clearly—

$$\text{Recorded or Crude DR} = \frac{\text{No. of deaths} \times 1000}{\text{Population}}$$

$$\left.\begin{array}{c}\text{DR for any given}\\ \text{age period}\end{array}\right\} = \left\{\frac{\left.\begin{array}{c}\text{No. of deaths}\\ \text{at that age}\end{array}\right\} \times 1000}{\text{No. living at that age}}\right.$$

$$\left.\begin{array}{c}\text{Calculated}\\ \text{mortality}\end{array}\right\} = \left\{\begin{array}{l}\text{Sum of deaths calculated for population}\\ \quad\text{living at each age period at the rates}\\ \quad\text{observed for each in the whole country.}\end{array}\right.$$

$$\text{Standard DR} = \frac{\text{Calculated mortality} \times 1000}{\text{Population at all ages}}$$

$$\left.\begin{array}{c}\text{Factor for correction of}\\ \text{crude or recorded DR}\end{array}\right\} = \frac{\text{DR of whole country}}{\text{Standard DR}}$$

$$\text{Corrected DR} = \text{Recorded DR} \times \text{Factor}$$

$$\left.\begin{array}{c}\text{Comparative}\\ \text{Mortality}\end{array}\right\} = \frac{\text{Corrected DR} \times 1000}{\text{General DR.}}$$

Infant and Child Mortality.

To calculate the infant death-rate on the population, or on the deaths at all ages, as is most commonly done, is absolutely idle. The only ratio which gives any useful information is that of the deaths of infants under one year to the number of births in the year, although the births are obviously more than the infant population actually living at any time. Errors arising from immigration and emigration may generally be left to correct one another. The child mortality, or the true death-rate of children under five years of age, is an important and instructive consideration. The child population, though known positively only in the year of the census, may be approximately estimated by a method which I first proposed in 1880.

Add together the total births of the five previous years, and deduct from this sum the number of deaths under one year of age in the first of these years, under two in the second, and so on. The remainder will give the number now living under the age of five. Indeed all estimates of the death-rate among persons of any given age period should be calculated on the number living of that age.

In like manner the "deaths of persons over 60" are frequently calculated on the deaths at all ages. In a stationary population this would show the proportion attaining that age, but in a normal increasing community this relation is lost in the constant addition of young persons to the population. The proportion of old persons to the population, and of the deaths of such to those at all ages, is far higher in France than in England, although the probable duration or expectation of life, the true index of longevity, is greater in this country.

When the mortality from a disease is practically confined to a certain age period, as that of scarlatina is to childhood, a death-rate from that cause calculated on the population of all ages is useless and fallacious in comparisons with that of populations differently constituted, and must be supplemented by one calculated on the number of persons living in each within the susceptible ages. Thus children under ten years of age, constituting 25 per cent. of the populations of London and Berlin, and only 12·5 per cent. of that of Paris, the recorded scarlatinal death-rates of 0·28 per 1000 in the former, and of 0·34 in the latter city, represent death-rates among the child populations of 1·12 and 2·72 per 1000 respectively, or as 1 : 2·43, not as would appear as 1 : 1·21.

The Correction of Published Death-Rates of the Years immediately preceding the Census.

The continuity of series of death-rates, &c. in successive decennia is often rudely interrupted by the discrepancy between the estimated population on which previous calculations had been based, and the true or enumerated population revealed by the census. Dr. Spottiswoode Cameron has worked out several formulæ by which this correction may be made without the tedious process of recalculation on the new basis. He has explained his method in full in *Public Health*, July 1892, but the results are shortly as follows—

(1) For the (census) years in which the true population is known, multiply the old rate by the factor (ζ) found by dividing the estimated population by the enumerated, for if P and p be the old and new estimates of the population, Δ and δ those of the death-rate, $\zeta = \frac{\delta}{\Delta} = \frac{P}{p}$.

(2) To find the correction factors for each year of the decade. The factors form a geometric series, the ratio between every two consecutive terms of which may be obtained by reducing the known correction for any year to the root whose index is the

time in years since the previous census; for if C be the previous census, and R and r the ratios of the series resulting in P and p,

$$\zeta = \frac{P}{p} = \frac{CR^n}{Cr^n} = \left(\frac{R}{r}\right)^n \therefore \frac{R}{r} = \sqrt[n]{\frac{P}{p}}.$$

By logarithms this is simpler than it seems.

For log. $\frac{R}{r}$ = log. $\frac{P}{p} \div n$ or log. ratio $= \frac{1}{n}$ (log. P − log. p).

(3) To find the correction for a single year, $\zeta = \frac{P}{n}$ for the last census being known, and the mid-year three months later than the date of the census. Divide the distance of the single year from the last census by $10\frac{1}{4}$, and multiply the log. of the known correction of the census year by the quotient: for $\frac{R}{r} = \sqrt[10\frac{1}{4}]{\frac{P}{p}} = \zeta^{\frac{1}{10\frac{1}{4}}}$. Let m be the distance in years, then $\left(\frac{R}{r}\right)^m = \sqrt[10\frac{1}{4}]{\left(\frac{P}{p}\right)^m} = \zeta^{\frac{m}{10\frac{1}{4}}}$, which is the factor required.

Expectation of Life and Life Tables.

Life tables profess to show how many of a million born die every year until all are extinct. They should be made by watching a generation throughout its existence, but they would then be out of date, since the conditions under which these persons passed their latter years might be more or less favourable than those of their youth. Actually, and probably more correctly, they are made by observing for a period of ten or twenty years the ages of all persons at death, and assuming the results to be applicable to the whole lifetime of each. Some, of course, were born and passed many years under better or worse conditions, and the same will be the case with the rising generation; but the error is greatly reduced, and life tables, frequently checked and corrected, are the best guide to the health of the community.

The first English life tables were constructed by the late Dr. Farr, of the General Register Office, and were calculated on the death-rates of 1838–54; but since that time very important changes have occurred in the death-rates at different ages; and consequently new tables have been issued by Dr. W. Ogle, his successor, on the basis of the death-rates of 1871–80. The following table gives the results both of the older and the later calculations; the first two columns in the male and female parts respectively giving the survivors at each year of life out of a million born of the corresponding sex, by the older and the newer calculation; and the two other columns giving similarly the expectation of life at each year.

AGE.	MALES.			
	Of 1,000,000 Born, the Number Surviving at the end of each Year of Life.		Mean After-lifetime (Expectation of Life).	
Years.	1838–54. 1.	1871–80. 2.	1838–54. 3.	1871–80. 4.
0	1,000,000	1,000,000	39·91	41·35
1	836,405	841,417	46·65	48·05
2	782,626	790,201	48·83	50·14
3	754,849	763,737	49·61	50·86
4	736,845	746,587	49·81	51·01
5	723,716	734,068	49·71	50·87
6	713,881	726,815	49·39	50·38
7	706,156	721,103	48·92	49·77
8	699,688	716,309	48·37	49·10
9	694,346	712,337	47·74	48·37
10	689,857	708,990	47·05	47·60
11	685,982	706,146	46·31	46·79
12	682,512	703,595	45·54	45·96
13	679,256	701,200	44·76	45·11
14	676,057	698,840	43·97	44·26
15	672,776	696,419	43·18	43·41
16	669,296	693,695	42·40	42·58
17	665,529	690,746	41·64	41·76
18	661,402	687,507	40·90	40·96
19	656,868	683,941	40·17	40·17
20	651,903	680,033	39·48	39·40
21	646,502	675,769	38·80	38·64
22	641,028	671,344	38·13	37·89
23	635,486	666,754	37·46	37·15
24	629,882	661,997	36·79	36·41
25	624,221	657,077	36·12	35·68
26	618,503	651,998	35·44	34·96
27	612,731	646,757	34·77	34·24
28	606,906	641,353	34·10	33·52
29	601,026	635,778	33·43	32·81
30	595,089	630,038	32·76	32·10
31	589,094	624,124	32·09	31·40
32	583,036	618,056	31·42	30·71
33	576,912	611,827	30·74	30·01
34	570,716	605,430	30·07	29·33

AGE.	FEMALES.			
	Of 1,000,000 Born, the Number Surviving at the end of each Year of Life.		Mean After-lifetime (Expectation of Life).	
Years.	1838–54. 5.	1871–80. 6.	1838–54. 7.	1871–80. 8.
0	1,000,000	1,000,000	41·85	44·62
1	865,288	871,266	47·31	50·14
2	811,711	820,480	49·40	52·22
3	782,990	793,359	50·20	52·99
4	764,060	775,427	50·43	53·20
5	750,550	762,622	50·33	53·08
6	740,584	755,713	50·00	52·56
7	732,771	750,276	49·53	51·94
8	726,116	745,631	48·98	51·26
9	720,537	741,727	48·35	50·53
10	715,769	738,382	47·67	49·76
11	711,581	735,405	46·95	48·96
12	707,770	732,697	46·20	48·13
13	704,155	730,122	45·44	47·30
14	700,581	727,571	44·66	46·47
15	696,917	724,956	43·90	45·63
16	693,050	722,084	43·14	44·81
17	688,894	718,993	42·40	44·00
18	684,378	715,622	41·67	43·21
19	679,463	711,946	40·97	42·43
20	674,119	707,949	40·29	41·66
21	668,345	703,616	39·63	40·92
22	662,474	699,141	38·98	40·18
23	656,509	694,521	38·33	39·44
24	650,463	689,759	37·68	38·71
25	644,342	684,858	37·04	37·98
26	638,148	679,822	36·39	37·26
27	631,891	674,661	35·75	36·54
28	625,575	669,372	35·10	35·83
29	619,201	663,959	34·46	35·11
30	612,774	658,418	33·81	34·41
31	606,296	652,747	33·17	33·70
32	599,769	646,957	32·53	33·00
33	593,196	641,045	31·88	32·30
34	586,575	635,003	31·23	31·60

AGE.	MALES.			
	Of 1,000,000 Born, the Number Surviving at the end of each Year of Life.		Mean After-lifetime (Expectation of Life).	
Years.	1838–54. 1.	1871–80. 2.	1838–54. 3.	1871–80. 4.
35	564,441	598,860	29·40	28·64
36	558,083	592,107	28·73	27·96
37	551,634	585,167	28·06	27·29
38	545,084	578,019	27·39	26·62
39	538,428	570,656	26·72	25·96
40	531,657	563,077	26·06	25·30
41	524,761	555,254	25·39	24·65
42	517,734	547,288	24·73	24·00
43	510,567	539,161	24·07	23·35
44	503,247	530,858	23·41	22·71
45	495,770	522,374	22·76	22·07
46	488,126	513,702	22·11	21·44
47	480,308	504,836	21·46	20·80
48	472,306	495,761	20·82	20·18
49	464,114	486,479	20·17	19·55
50	455,727	476,980	19·54	18·93
51	447,139	467,254	18·90	18·31
52	438,099	457,022	18·28	17·71
53	428,801	446,510	17·67	17·12
54	419,256	435,729	17·06	16·53
55	409,460	424,677	16·45	15·95
56	399,408	413,351	15·86	15·37
57	389,088	401,740	15·26	14·80
58	378,481	389,827	14·68	14·24
59	367,570	377,591	14·10	13·68
60	356,330	365,011	13·53	13·14
61	344,744	352,071	12·96	12·60
62	332,789	338,820	12·41	12·07
63	320,451	325,256	11·87	11·56
64	307,720	311,368	11·34	11·05
65	294,588	297,156	10·82	10·55
66	281,064	282,638	10·32	10·07
67	267,160	267,829	9·83	9·60
68	252,901	252,763	9·36	9·14
69	238,328	237,487	8·90	8·70

AGE.	FEMALES.			
	Of 1,000,000 Born, the Number Surviving at the end of each Year of Life.		Mean After-lifetime (Expectation of Life).	
Years.	1838–54. 5.	1871–80. 6.	1838–54. 7.	1871–80. 8.
35	579,908	628,842	30·59	30·90
36	573,192	622,554	29·94	30·21
37	566,431	616,144	29·29	29·52
38	559,619	609,599	28·64	28·83
39	552,758	602,924	27·99	28·15
40	545,844	596,113	27·34	27·46
41	538,876	589,167	26·69	26·78
42	531,849	582,104	26·03	26·10
43	524,765	574,919	25·38	25·42
44	517,617	567,612	24·72	24·74
45	510,403	560,174	24·06	24·06
46	503,122	552,602	23·40	23·38
47	495,768	544,892	22·74	22·71
48	488,339	537,043	22·08	22·03
49	480,833	529,048	21·42	21·36
50	473,245	520,901	20·75	20·68
51	465,572	512,607	20·09	20·01
52	457,814	504,188	19·42	19·34
53	449,966	495,645	18·75	18·66
54	442,027	486,973	18·08	17·98
55	433,331	477,440	17·43	17·33
56	424,239	467,443	16·79	16·69
57	414,761	456,992	16·17	16·06
58	404,895	446,079	15·55	15·45
59	394,636	434,695	14·94	14·84
60	383,974	422,835	14·34	14·24
61	372,895	410,477	13·75	13·65
62	361,387	397,644	13·17	13·08
63	349,436	384,319	12·60	12·51
64	337,031	370,495	12·05	11·96
65	324,165	356,165	11·51	11·42
66	310,833	341,326	10·98	10·90
67	297,048	325,988	10·47	10·39
68	282,819	310,170	9·97	9·89
69	268,177	293,899	9·48	9·41

AGE.	MALES.			
	Of 1,000,000 Born, the Number Surviving at the end on each Year of Life.		Mean After-lifetime (Expectation of Life).	
	1838–54.	1871–80.	1838–54.	1871–80.
Years.	1.	2.	3.	4.
70	223,490	222,056	8·45	8·27
71	208,453	206,539	8·03	7·85
72	193,297	190,971	7·62	7·45
73	178,114	175,449	7·22	7·07
74	163,003	160,074	6·85	6·70
75	148,076	144,960	6·49	6·34
76	133,453	130,227	6·15	6·00
77	119,251	115,986	5·82	5·68
78	105,592	102,359	5·51	5·37
79	92,587	89,449	5·21	5·07
80	80,343	77,354	4·93	4·79
81	68,946	66,153	4·66	4·51
82	58,471	55,842	4·41	4·26
83	48,970	46,489	4·17	4·01
84	40,471	38,132	3·95	3·58
85	32,979	30,785	3·73	3·56
86	26,476	24,436	3·53	3·36
87	20,926	19,054	3·34	3·17
88	16,268	14,576	3·16	2·99
89	12,428	10,926	3·00	2·82
90	9,321	8,015	2·84	2·66
91	6,859	5,748	2·69	2·51
92	4,946	4,025	2·55	2·37
93	3,492	2,749	2·41	2·24
94	2,411	1,828	2·29	2·12
95	1,628	1,183	2·17	2·01
96	1,071	742	2·06	1·90
97	688	452	1·95	1·81
98	430	266	1·85	1·72
99	262	151	1·76	1·65
100	154	82	1·68	1·61

AGE.	FEMALES.			
	Of 1,000,000 Born, the Number Surviving at the end of each Year of Life.		Mean After-lifetime (Expectation of Life).	
	1838–54.	1871–80.	1838–54.	1871–80.
Years.	5.	6.	7.	8.
70	253,161	277,225	9·02	8·95
71	237,822	260,207	8·57	8·50
72	222,230	242,934	8·13	8·07
73	206,464	225,497	7·71	7·65
74	190,620	208,003	7·31	7·25
75	174,800	190,566	6·93	6·87
76	159,126	173,316	6·56	6·51
77	143,722	156,392	6·21	6·16
78	128,711	139,927	5·88	5·82
79	114,229	124,065	5·56	5·50
80	100,394	108,935	5·26	5·20
81	87,323	94,662	4·98	4·90
82	75,119	81,305	4·71	4·63
83	63,862	68,966	4·45	4·37
84	53,615	57,723	4·21	4·12
85	44,419	47,631	3·98	3·88
86	36,284	38,710	3·76	3·66
87	29,202	30,958	3·56	3·46
88	23,135	24,338	3·36	3·26
89	18,027	18,788	3·18	3·08
90	13,802	14,225	3·01	2·90
91	10,376	10,553	2·85	2·74
92	7,650	7,658	2·70	2·58
93	5,526	5,429	2·55	2·44
94	3,908	3,756	2·42	2·30
95	2,704	2,533	2·29	2·17
96	1,827	1,661	2·17	2·11
97	1,204	1,057	2·06	2·03
98	774	653	1·96	1·83
99	483	389	1·86	1·73
100	295	225	1·76	1·62

Class Mortalities.

Fallacious Inferences.

It is very difficult to form a correct estimate of the health of any group of individuals or particular section of the community. In all cases the death-rate observed in the class in question must be compared with that of persons generally of like sex and age periods, not with that of the entire population. Thus a death-rate of 10 per 1000 among factory girls aged 15—25 in a town where the general death-rate was 22 would be very high, since that for females of that age period is about 6. This precaution is sufficient when, there being nothing specially unfavourable to health in their occupation, any excessive mortality must be ascribed to insanitary surroundings or irregular habits; or conversely when there is reason to believe that the unhealthy conditions of the employment are of a preventible kind. But it would be obviously unfair to expect that all trades could be rendered equally healthy; and when a certain amount of danger to life or unhealthiness is unavoidable, the death-rate should also be compared with that of some other group of workers in the same or a similar industry, thus giving a practicable as well as an ideal standard or aim. It may be impossible for miners to reach the mean age of farmers, but there is no reason why all colliers should not enjoy the same health as those of Durham, if only their pits were as well ventilated.

Again, the healthiness of a trade may be obscured, or its unhealthiness exaggerated by its making little demand on muscular strength, and thus attracting men of originally feeble constitutions, and boys who are considered unfitted for harder work. Other occupations, of which the dangerous and unhealthy character is evident from the excessive mortality in advanced life, do not manifest any such effects for perhaps ten or even twenty years, none but men of powerful frames and great endurance being eligible.

Selected Classes.

Besides the natural selection consequent on the character of the work, there is another in the medical examination required for admission into the Army, Police, and other services. The death-rate of these should be compared with that, not of others of their own age only, but of the selected lives of insurance offices for like age periods. Even this standard gives far too favourable results, since in the Army, &c., men are invalided and discharged in all cases of chronic illness, and very few deaths other than those from acute disease or violence appear on the books.

Changing Populations.

The inmates of prisons, hospitals, and to a certain extent of military stations cannot be fairly compared with fixed populations, though they may with others of a like character. The death-rate must be calculated, not on the average strength, but on the number passing through in the course of the year. Thus in a hospital with 100 beds, where the average period of treatment is six weeks, 100 deaths per annum does not represent a mortality of 100 per cent., but 100 in 800 = 12·5 per cent. It is, however, seldom that any trustworthy comparisons can be made between different hospitals, since the nature and gravity of the cases, as well as the length of time during which patients are retained in the wards, differ widely; indeed the alleged greater success, *i. e.* the lower death-rate, in small provincial hospitals, than in those in great cities as London, Liverpool, and Glasgow, is wholly explicable by their totally different circumstances. The only legitimate comparisons are those of like operations, or of diseases such as fevers, &c., which, unless they die in the hospital, are discharged only when cured, not when simply relieved. In prisons the convicts undergoing long and short sentences should be considered apart, for there is no doubt as to the influence of time in manifesting effects on the health not seen at first.

But while "corrected" death-rates are applicable to permanent or entire populations, and "age mortalities" to classes and trades, neither is properly available in the case of changing populations, especially of those in which ill-health is a ground for discharge, and any deaths from causes other than acute illness, accident, or violence occur only through inadvertence or delay in the removal of the patient from the roll.

Vital Statistics of Trades and Professions.

Some occupations are less favourable to health or longevity than others, some being healthy but dangerous, others involving long or irregular hours, mental strain, contact with poisons, exposure to irritating dust, or extremes of temperature, work in ill-ventilated rooms, or temptations to intemperate habits. But most of the current statements and conclusions on this subject are invalidated by one or more fallacies, *e.g.* neglecting the age at which such employment is undertaken or discontinued, the class of persons attracted and the difference between employers and employed, as well as the disturbing influence of the marriage-market on female employment. There are some positions attainable only after long and successful careers, or which are filled by elderly and respectable men no longer capable of laborious work. On the other hand, some are restricted by age or are suited to young persons, who after a few years seek more lucrative occupations.

In all these the mean age at death is utterly delusive. When, for instance, Dr. Rohé ascribes a higher longevity to judges than to lawyers, to pilots and lighthouse keepers than to seamen, and to professors than to students (!), he merely states a truism, that old men live longer than those who die young. For the same reason, much subdivision of occupations, is an error.

Valid and Fallacious Inferences from Mortality and Age at Death.

Most females follow their employments only until by marriage they cease to be self-supporting, and the mean age at death of female clerks, shop assistants, and domestic servants is valueless. To give that of ladies' maids as 36 and of nurses as 60 is an abuse of statistics.

Occupations demanding strength and endurance are open only to the most robust, while others attract the feebler members of the same classes.

Even with these reservations the only valid comparisons that may be made between the health of any class and that of the general population are those based on the respective mortality at like age periods; and in the case of different trades or occupations between those on which men in most respects similarly constituted enter at the same age, and which they follow to the end of their working life.

Thus one may legitimately compare the several liberal professions with one another, or such trades as bakers, compositors, tailors and shoemakers, but soldiers can only be compared with the civil population between the ages of 20 and 30 years, and it would be obviously unfair to compare navvies with compositors, or shipwrights with hotel waiters.

In fact the *age at death* is illusory, and the *death-rates* in the earlier and later halves of working life, or from 25 to 45 and 45 to 65 years, give the most trustworthy data for comparisons of the kind here indicated as legitimate. Before 25 occupation has not had time to exert any appreciable influence, and after 65 the well-to-do have retired and the poor are supported by their families or the state, or have taken to lighter employments.

The crude generalization that the death-rate varies directly as the density of the population is only conditionally true, except as regards such highly infectious diseases as measles, whooping-cough, and scarlatina. These deaths are above the average in Peabody and other block-dwellings, the sanitary arrangements of which are good, and in which, notwithstanding the density of the population, *i.e.* the number of persons on a given area of ground, the death-rate from all other causes is exceptionally low. The fact is, that density of population commonly implies over-crowding, and this is at once the cause and the effect of poverty, vice, and all forms of misery to which, and not to the concentration of population *per se*, the high death-rate is really due.

Among the circumstances, essential or accidental, which render certain employments more or less injurious to health, may be mentioned—

(1) Prolonged occupation of ill-ventilated and crowded rooms, aggravated perhaps by late hours or by cramped postures.

(2) Exposure to cold winds and wet, especially when there is no demand for muscular exercise.

(3) Exposure to extreme heat, to steam, and still more to sudden changes of temperature.

(4) Inhalation of dust, whether metallic, mineral, or organic, and whether acting mechanically or chemically on the mucous membrane of the bronchi.

(5) Contact with, or inhalation or ingestion of poisonous matters, dust, or fumes, as lead, arsenic, phosphorus, mercury, chlorine, acids, gases, &c.

(6) Contact with septic matters, and with animal substances infected with specific diseases, as anthrax or glanders.

(7) Mental strain and anxiety, involving broken rest and irregular habits.

(8) Intemperance alone or associated with, and often induced by, one or other of the foregoing.

In the following table given by Dr. Ogle these death-rates are given for the decennium 1861—1871, and for the three years 1880-2, which is the latest period for which an analysis has been made. The classification is also well marked and comprehensive.

The comparative mortality of some other trades, according to Dr. Ogle's tables, are general-shopkeepers, 865; ironmongers, 895; fishmongers, 974; milk, butter, and cheese-mongers, 1009; greengrocers, 1015; hatters, 1064. The standard of comparative mortality ought, however, to be that of "occupied males" (who here stand at 967) rather than of "all males," since the latter include all those who by reason of ill-health, bodily infirmity, or irregular habits are incapable of following any occupation, and who, forming a large proportion of "unoccupied males," raise the comparative mortality of the class to 2182.

At least one-fifth of the deaths among miners are due to accidents, and this is the case also with quarrymen. Except in Cornwall they are remarkably free from phthisis, though in South Wales the phthisis mortality appears somewhat higher than that of the general population.

Occupation.	Mean Annual Death-rate per 1000 living.				Comparative Mortality Figure.
	1860—1871. Years of Age.		1880-1-2. Years of Age.		1880-1-2. Years of Age.
	25–45	45–65	25–45	45–65	25–65
All males	11·27	23·98	10·16	25·27	1000
Occupied males ...	—	—	9·71	24-63	967
Clergy, Priests, Ministers	5·96	17·31	4·64	15·93	556
Gardeners and Nurserymen	6·74	17·54	5·52	16·19	599
Farmers and Graziers	7·66	17·32	6·09	16·53	631
Agricultural Labourers	—	—	7·13	17·68	701
Schoolmasters and Teachers	9·82	23·56	6·41	19·98	719
Grocers	9·49	17·15	8·00	19·16	771
Fishermen	11·26	15·84	8·32	19·74	797
Carpenters and Joiners	9·44	21·36	7·77	21·74	820
Booksellers, Stationers	10·84	21·36	8·53	20·57	825
Barristers, Solicitors ...	9·87	22·97	7·54	23·13	842
Drapers and Warehousemen	14·34	26·33	9·70	20·96	883
Grooms and private Coachmen	—	—	8·53	23·28	887
Coal miners, mean of 6 districts	—	—	7·64	25·11	891
Plasterers and Whitewashers	9·50	27·9	7·79	25·07	896
Watch and Clockmakers	10·78	24·90	9·26	22·64	903
Tanners, Fellmongers	10·43	26·57	7·97	25·37	911
Shoemakers	10·39	22·30	9·31	23·36	921
Artists, Sculptors, Engravers, Architects...	11·73	22·91	8·39	25·07	921
Commercial Travellers	12·28	29·00	9·04	25·03	928
Corn Millers	9·32	26·65	8·40	26·62	957
Bakers, Confectioners	10·72	26·39	8·70	26·12	958
Builders, Bricklayers, Masons	11·43	27·16	9·25	25·59	969

Blacksmiths	10·07	23·88	9·29	25-67	973
Commercial Travellers, Insurance Agents ...	14·28	28·88	10·48	24·49	996
Tobacconists	13·19	21·76	11·14	23·46	1000
Chemists and Druggists	13·92	23·56	10·58	25·16	1015
Tailors	12·92	24·79	10·73	26·47	1051
Printers	13·02	29·38	11·12	26·60	1071
Wool & Worsted Manufacturer Operatives, West Riding ...	—	—	9·71	27·50	1082
Cotton & Linen ditto, Lancashire	—	—	9·99	29·44	1088
Medical Men	13·81	24·55	11·57	28·03	1122
Law Clerks	18·75	37·05	10·77	30·79	1151
Butchers	13·19	28·37	12·16	29·08	1170
Glass Blowers, &c. ...	13·19	29·32	11·21	31·71	1190
Plumbers, Painters, and Glaziers	12·48	34·66	11·07	32·49	1202
Cutlers, Scissor, Saw, Tool and Needle Mft.	11·88	32·74	11·71	34·42	1273
Carters, Carriers, and Hauliers	—	—	12·52	33·00	1275
Bargemen, Lightermen and Watermen ...	14·99	30·78	14·25	31·13	1305
Musicians and Musicmasters	18·94	34·76	13·78	32·39	1314
Hairdressers	15·11	30·10	13·64	33·25	1327
Brewerymen	19·26	36·86	13·90	34·25	1361
Cabmen, Omnibusmen	15·94	35·28	15·39	36·83	1482
Chimneysweeps ...	17·53	42·87	13·73	41·54	1519
Innkeepers, Licensed Victuallers	18·01	34·14	18·02	33·68	1521
Messengers, Porters, Watchmen	—	—	17·07	37·37	1565
Filemakers	16·27	42·30	15·29	45·14	1667
Earthenware Manufacturers and Potters ...	12·59	41·75	13·70	51·39	1742
Cornish Miners ...	11·94	41·73	14·77	53·69	1839
Costermongers, Hawkers, &c.	20·09	37·82	20·26	45·33	1879
General Labourers (London)	18·35	40·64	20·62	50·85	2020
Inn and Hotel Servants	21·91	42·19	22·63	55·30	2205

Influence of Ventilation in Production of Phthisis and Respiratory Diseases.

The influence of defective ventilation in the production of phthisis is seen in the following table.

	Phthisis.	Diseases of Respiratory system	The two together.
Fishermen	108	90	198
Agriculturists	115	122	237
Grocers	167	116	283
Drapers	301	129	430
Tailors	285	186	471
Printers	461	166	627

The influence of the inhalation of dust, with or without defective ventilation, in the production of phthisis and other respiratory diseases is seen in the following table—

	Comparative Mortality figure.	Phthisis.	Other Diseases of Respiratory organs	The two together.
Coal-miners	891	126	202	328
Carpenters	820	204	133	337
Bakers, &c.	958	212	186	398
Masons, Bricklayers	969	252	201	453
Wool manufactrs.	1032	257	205	462
Cotton manufctrs.	1088	272	271	543
Quarrymen	1122	308	274	582
Cutlers, &c.	1309	371	389	760
Tile Makers	1667	433	350	783
Earthenware mfrs.	1742	473	645	1118
Cornish miners	1839	690	458	1148
Fishermen	797	108	90	198

Effect of Dust on Health.

The "consumption" so-called to which all persons engaged in dusty occupations are liable must be distinguished from that incident to employments carried on in ill-ventilated and crowded rooms, whether the air be charged with dust or not. Tailors, printers, &c., are prone to tubercular phthisis, one tuberculous individual infecting the others; but, as Dr. Birch Hirschfeld has shown, men working in the open air, or alone even in small workshops, at trades of a dusty nature, while not exhibiting any greater tendency to tubercular phthisis than others, are prone to bronchitis, catarrhal and interstitial pneumonia, bronchiectasis, and every form of non-tubercular phthisis, to which he gives the collective name of pneumoconiasis.

Merkel and Zenker found from 0·8 to 1·4 of iron in the lungs of needle-grinders, and Giesseler, 34 per cent. of silica and 10 per cent. of alumina in the ash of the lungs of workers on French millstones.

General Conclusions.

In the year 1880–1–2, there were in England and Wales 1000 deaths annually per 64,641 males, between the ages of 25 and 65, of whom 41,920 were under and 22,721 above 45 years of age. The comparative mortality is the number of deaths that would have occurred with the observed death-rate of the class in question among 64,641 members of that class, supposing them to be distributed as to age in like manner as the general adult male population. Thus among so many clergy 556 deaths would have been recorded instead of 1000, and among the same number of medical men, 1122. We thus obtain an exact measure of the comparative waste of life in each class, whether due to the occupation itself, or to the habits of those following it.

Thus while the high mortality in some occupations, as knife and needle-grinding, is inseparable from the conditions under which they are at present carried on; in others, as the profession of music, it can be accounted for only by the irregular and intemperate habits into which such men generally though not necessarily fall; and among cabmen and street-hawkers, for instance, both factors, or intemperance and exposure or hardships, combine to bring about the result. But a very frequent fallacy is the singling out of one of several causes, one, it may be, of undoubted influence, as if it were the sole cause, and thus ascribing to it an exaggerated importance.

Thus the excessive mortality and short duration of life among men engaged in the public-house business is constantly referred to by "temperance advocates" as the result of the habits of drinking to which they are prone. But it is manifestly unjust to ignore the other unhealthy conditions of the trade. If the assistants in shops, if tailors and dressmakers suffer from the effects of long hours, in heated and over-crowded rooms, surely the barman, barmaid, and waiter are exposed to the same influences in a still higher degree, and would, even if abstainers, suffer in proportion.

In forming any conclusion as to the healthiness of a particular employment, the age and physique of the individuals, and *all* their circumstances, essential and accidental, as well as the conditions of the work itself, must be taken into account.

Preventible Diseases.

In theory all disease ought to be preventible, and old age the sole cause of death, but till the "millennium" we cannot get rid of constitutional diseases, and those having their origin in accidents, hardship, and personal habits. By preventible diseases we mean those amenable to sanitation, or due to infection from one individual to another.

Mean Annual Death-rate per 1000 *Living from certain Diseases and from all causes in Successive Quinquennia from* 1860—1890, *etc., in England and Wales.*

	1861-65	1866-70	1871-75	1876-80	1881-85	1886-90
Smallpox ...	·2188	·1048	·4114	·0784	·0784	·0132
Measles	·4570	·4288	·3734	·3854	·4130	·4684
Scarlatina ...	·9832	·9602	·7590	·6804	·4358	·2406
Typhus ...	·0224	·8504	·0816	·0334	·0228	·0066
Enteric ...			·3740	·2774	·2160	·1792
Continued ...			·1402	·0692	·0342	·0166
Whooping cough	·5160	·5452	·4990	·5276	·4386	·4436
Diphtheria ...	·2470	·1268	·1208	·1218	·1562	·1696
Diarrhœa and Cholera,	·9170	1·2360 (Cholera in 1866)	1·0316	·8540	·6720	·6810
Phthisis	2·5280	2·4492	2·2192	2·0424	1·8304	1·6354
Childbirth ...	·1134	·1060	·1076	·0796	·0728	·0660
All causes ...	22·5950	22·4365	21·9752	20·8170	19·4034	18·8954

These results are really due to sanitary improvement consequent on legislation, for no such difference is to be observed between the decades 1850-60 and 1860-70. Smallpox is subject to waves of epidemic, but all the others have steadily declined, except whooping cough, which is independent of sanitary measures. Measles shows a tendency to an excessive prevalence every third year, and scarlatina every second, but the successive epidemics vary greatly in intensity of type, so that there is no constant proportion between the mortality and the prevalence of the disease, three years of low mortality being as a rule followed by two of high.

The following table shows the months of highest and lowest mortality, and the ratio of each to the mean in the most constantly prevalent epidemic diseases.

Diseases.	Highest mortality in	Per cent. above average.	Lowest mortality in	Percentage below average.
Scarlatina ...	Oct.	60	Mar.—May	35
Diphtheria ...	Nov., Dec.	20	May, June	15
Measles	(1) Dec.	40	(1) Sept.	30
(two waves)	(2) June	20	(2) Febr.	20
Whooping Cough	Mar., Apr.	40	Sept., Oct.	40
Enteric Fever	Nov.	30	June	30
Diarrhœa ...	July(end),to Aug. (mid.)	300	Dec.—May	70

Permissible Mortality from Preventive Diseases.

It is the aim of preventive medicine to reduce the mortality from preventible diseases, but at present the unavoidable or, as one might say, permissible death-rate per 1000 living may be taken in the great towns as—

Enteric fever ...	0·1
Scarlatina	0·2
Diphtheria	0·3
Measles and Whooping Cough	0·4
Diarrhœa	0·6
Phthisis	1·5

Anything above these rates should arouse suspicion. The mean so-called zymotic death-rate is of little value, for an outbreak of scarlatina and measles in the public schools might temporarily raise the mortality of the most perfectly administered town higher than that of one where diarrhœa, diphtheria, and enteric fever were always present.

Diphtheria, enteric fever, diarrhœa, and phthisis should be the chief objects of the sanitarian's attention.

Only where notification is in force can one rightly estimate the extent and the intensity of an epidemic. The ratio of cases to the population indicates the prevalence of the disease, and that of deaths to cases, the "case mortality," or fatality, the severity of the type, factors in the total mortality, standing in no constant or definite relation to one another.

In mathematical language the mortality from any disease is a function, that is, the resultant of the prevalence and the fatality, and the latter depends partly on the age of the person attacked.

Causes of Infant Mortality.

The question of infant mortality is closely connected with that of infant feeding, and the most surprising differences are mainly, if not wholly, explicable in this way.

Where improper feeding is the chief factor, a large proportion of the deaths are due to diarrhœa and other disorders of the stomach and bowels, convulsions, etc., and relatively fewer to other causes of a less preventible kind.

That which above all other conditions determines the infant mortality in a community is not climate or density of population, or even poverty, unless extreme, but the employment of married women in factories, or otherwise, under circumstances incompatible with the nursing of their own infants. Thus while in all manufacturing towns it is above the average, and in the residential towns it is below, in the chief seats of the textile industries and others in which female labour is most largely used, it ranges from 180 to 200, or considerably more, per 1000; while in the poor and purely agricultural counties of Wilts and Dorset it is not over 105, and in Ireland as a whole 109, or excluding the two great towns of Dublin and Belfast, in which it is 172 and 163 respectively, we have for agricultural Ireland 94 only. But insanitary conditions combined with abject poverty, as in parts of Russia and Italy, or alone as in Iceland, may lead to an appalling loss of infant life.

Infant Mortality from all causes per 1000 *Births.*

	1871-80	1881-90	
England	148	—	For later rates see Tables on pages 48, 49.
London	156	151·5	
Liverpool	199	182·7	
Manchester	178	178·9	
Salford	182	186·5	
Leicester	200	197·9	
Birmingham ...	172	173·5	
Portsmouth	141	138·5	

EPIDEMIC WAVES AND CURVES.

Besides the seasonal curves already mentioned as observed in the annual prevalence of most of the infectious diseases in certain months, which appear to be due to conditions of temperature, humidity, or the movements of the ground water favouring the development of the microbes, *e. g.* of enteric fever and diarrhœa, in the soil, or to those conducing to the diminished resisting power on the part of man, as catarrhal affections of larynx, pharynx, and bronchi favouring infection of those tracts, there is a tendency towards a rapid increase in the virulence and fatality of a disease during the rise of an epidemic, and to a diminution towards its close, sometimes as in the case of cholera ascribed to the last mode of treatment adopted.

There are also periodical recurrences of epidemics, even of diseases appearing every year, and never wholly absent. These waves, better seen in the case of measles than of any other disease, are of two kinds, the lesser recurring every three or four years, and the greater at intervals of ten or twelve. The lesser are probably due to the re-accumulation of a young and susceptible population, but the cause of the greater is more obscure. In epidemic years it seems as if the greater virulence of the poison led to the implication of the less susceptible and more refractory individuals, resulting in a lesser general fatality. The whole question calls for a study that it has not yet received.

Scarlatina, which in the Seventies was a very fatal disease, has for the last ten years assumed a much milder character, at least in London, but whether this will continue or be succeeded by a recrudescence remains to be seen.

FALLACIES.

Fallacies of Registration.—All deaths (except those of infants incorrectly reported as still-born) are registered, but a large number of births escape registration, from ignorance or shame of illegitimacy, or for the purpose of avoiding vaccination.

Children in their first, second, or third years are not unfrequently returned in the census papers, and in certificates of death, as one, two, or three years old, and adults, from ignorance, and women from vanity, are apt to misstate their ages.

Fallacies as to Causes of Death.—In many parts of the country the causes of death, in the absence of any medical certificate, are entered by the registrar on the evidence of the friends, or are suggested by himself. Thus the apparent prevalence of "consumption" in Wales is partly due to all lingering diseases being so called by the ignorant people. Even medical certificates are very often inaccurate, either from faulty diagnosis or from the patients having been attended by unqualified assistants, or, as is not unfrequently the case in rural districts, seen by the medical man once only just before death.

Fallacies of Age.—Longevity in the case of individuals, and a high mean duration of life are different things; and the proportion of persons of a more or less advanced age is no indication of the mean duration, but depends mainly on the proportion of children, *i. e.* on the birth-rate; thus the percentage of persons over 60 years is much greater in France than in England, because there are fewer children in the former country, though life is really longer here.

Fallacy of Substitution of Diseases.—It has been said that the reduction of one cause of death leads to an increase of others. In one sense this is true, since every one must die at some time from some cause or other, and the success of sanitary measures is seen in the reduction of the deaths from preventible causes. But the fallacy referred to consists in ignoring the influence of mean age on the prevalent diseases. There are diseases respectively of early, middle, and advanced life. Thus, an increase in the deaths from the last may really indicate a general prolongation of life from improvement in the public health.

Fallacies of Smallpox and Vaccination

Anti-vaccinationists point to the fact that the deaths from smallpox were somewhat more numerous in the six years following the passing of the Vaccination Act than in those preceding. But if the deaths are analyzed according to age, it will be found that the greater number of those persons who died in the second period were born in the first, and therefore equally unaffected by the passing of the Act with those who had died before it.

Age.	Deaths from 1858–67.	1868–75.
Under 5 years	22,885	18,300
5 to 10 ,, ...	4,788	7,981
Over 10 ,, ...	13,943	27,625
	41,616	53,906

If we take three consecutive periods of four years each, instead of one of eight years, subsequent to the passing of the Act, the decline in the mortality of all children will be more clearly seen, as well as that they ceased to show the same degree of susceptibility about the age of ten.

Age.	Deaths from 1868–71.	1872–75.	1876–79.
Under 5 years	11,141	7,159	2,140
5 to 10 ,, ...	4,206	3,775	957
Over 10 ,, ...	14,016	13,636	5,445
	29,363	24,570	8,542

The whole of the 27,600 children who died over 10 years of age in the eight years subsequent to the passing of the Act, and a large proportion of the others, must have been born in the years preceding the Vaccination Act, and therefore have been in no way benefited thereby.

Again, however strictly enforced vaccination may be, the deaths of children as yet unvaccinated should be distinguished, whereas the opponents of vaccination argue as if from the moment at which it has been made obligatory within the first three, six, or twelve months of life every child born into the world were at once a sharer in the alleged benefits of vaccination. *Quod est absurdum.*

In like manner the actual number of vaccinated and unvaccinated persons of all ages who have been attacked and died of smallpox, though it may illustrate the modifying influence of vaccination, tells us nothing of the protection it affords against infection, unless we know the number of each class, and thus the proportions in which they suffered. The number of those who have already had smallpox, and are, therefore, as a rule, insusceptible, should also be ascertained.

TABULATION OF CAUSES OF DEATH.

The Medical Officer of Health must append to his annual report tables of the deaths at all ages and from all causes in forms prescribed by the L.G.B., and may add a complete return on the model of those of the Registrar General, but for practical purposes connected with public health, and for weekly or monthly issue, a much simpler form is preferable. It should be divided into a few well-marked age periods, as infancy, early and late childhood, adolescence, early and late adult life, and old age, each of which is distinguished by its several dangers, and social and industrial conditions. These periods would be under 1 year, 1 to 5, 5 to 10, 10 to 20, 20 to 40, 40 to 60 or 65, and all over the last.

The preventible, or so-called zymotic diseases and phthisis should be given in detail, but croup and diphtheria be considered as one disease, and, together with any fatal cases of putrid sore throat, &c., be ranked as diphtheria. The M. O. H. may, if he explain his reasons for so doing, correct such returns as "scarlatina turning to diphtheria," or early cases of the former followed by the latter in the same family or school as errors of diagnosis, the disease having in all probability been diphtheria from the first. Thus again, so-called "cholera" when reported in the absence of an epidemic, "cholera infantum," and so called "dysentery," except in the case of persons returning invalided from the tropics, &c., should be lumped together as "diarrhœa and enteritis." Tubercular and non-tubercular phthisis are not distinguished by the majority of medical practitioners, and should form a single item, all "other respiratory diseases" being grouped under a second head.

Cancers of whatever organ should form a single group, as should septicæmia, pyæmia, &c., puerperal "fever" or septicæmia excepted. Deaths in childbed other than puerperal fever or septicæmia call for particular notice; and in all deaths whatever returned as peritonitis, septicæmia, hæmorrhage, and the like, the antecedent cause or condition should be ascertained; such "immediate" causes are always suspicious, being often intended to divert attention from the primary cause, and to conceal crime or malpractice. Syphilis deserves a place, with the remark that the reported mortality from the congenital disease does not represent the whole truth, many cases being returned as "tabes," "marasmus," "thrush," &c.

"Diseases of the nervous system" may form a single group, from which, however, "convulsions" and "teething," which is not a disease or cause of death, should certainly be excluded. Convulsions may be a symptom of disease of the nervous centres, but such cases will doubtless have been returned as meningitis, &c., and the vast majority are in fact symptoms of gastro-intestinal derangement, the result of improper feeding.

Few diseases are more amenable to preventive measures than tuberculosis, for while the immediate cause of the pulmonary form is the inhalation of the spores in the form of dust from the dried sputa, susceptibility implies a certain feebleness of resistance, and pulmonary catarrhs, which are directly connected with damp, overcrowding, want, and insanitary surroundings, and are greatly influenced by sanitary improvements. Thus phthisis has been reduced by half in the last forty years.

The infantile forms, mostly intestinal, are contracted by the ingestion of the bacilli with the milk of tuberculous cows, and alone are on the increase with the wider use of the bottle. The meninges are invaded through the lymphatic duct.

Mortality from Phthisis in Groups of Ages, 1861–96.
(*Per Million at each Age.*)

	Periods.	All Ages.	0–.	5–.	10–.	15–.	20–.	25–.	35–.	45–.	55–.	65–.	75–.
Males.	1861–70	2467	990	431	605	2190	3883	4094	4116	3861	3297	2024	659
	1871–80	2209	783	310	481	1675	3092	3699	4120	3860	3195	1925	603
	1881–90	1847	553	253	342	1287	2333	3024	3562	3488	2916	1816	688
	1891–95	1633	467	197	260	1076	2026	2518	3268	3205	2687	1572	563
	1896 ...	1485	392	150	203	913	1848	2285	3029	3043	2599	1329	512
Females.	1861–70	2483	947	477	1045	3112	3967	4378	3900	2850	2965	1239	447
	1871–80	2028	750	375	846	2397	3140	3543	3401	2464	1777	1093	407
	1881–90	1609	518	327	699	1800	2315	2787	2730	2053	1512	974	397
	1891–95	1303	421	260	561	1428	1740	2155	2305	1742	1294	800	350
	1896 ...	1138	349	204	454	1183	1562	1874	2090	1543	1170	676	375

A tabular form, in which the births and deaths for each month in the year, the former divided into legitimate and illegitimate, and the latter arranged under various heads, the infectious diseases separately, and the others in appropriate groups, every one of these being also calculated on the total number of deaths, the population, &c., is generally employed by the M.O.H. of the larger cities of Germany, and from its remarkable compactness and comprehensiveness, well deserves adoption here.

Month.	Births.			Deaths.			Ages of the Dying.											
							0—1 Years.		2—5 Years.									
	Male.	Female.	Total.	Male.	Female.	Total.	Legitimate.	Illegitimate.	Legitimate.	Illegitimate.	6—15 Years.	16—20 Years.	21—30 Years.	31—40 Years.	41—60 Years.	61—80 Years.	81 and upwards.	Age unknown.
January																		
February																		
March																		
April																		
May																		
June																		
July																		
August																		
September																		
October																		
November																		
December																		
Totals.	-	-	-	-	-	-	— $^0/_0$	— $^0/_0$	— $^0/_0$	— $^0/_0$	-	-	-	-	-	-	-	-
	— $^0/_{00}$ of the Population.			— $^0/_{00}$ of the Population.			Total. — —		Total. — —		—	—	—	—	—	—	—	—
	Illegitimate. M. F. T. — — —						Per cent. of											
							—		—		-	-	-	-	-	-	-	-
	= — $^0/_0$ of the Births.						Per 10,000 of											

Additional particulars and Observations.

Causes of Death.																							
Infectious Diseases.										Other Prevalent Diseases.								Violent Deaths.					
Small-pox.	Scarlatina.	Enteric Fever.	Diphtheria and Croup.	Typhus.	Erysipelas.	Puerperal Fever.	....	....	Other Inf. Diseases.	Phthisis.	Pneumonia.	Other Resp. Diseases.	Diarrhoea.	....	....	....	All Other Diseases.	Accident.	Suicide.	Homicide.	Uncertificated Deaths.	Death-rate per 1000 on the Monthly Estimated Pop.	
																							Mean Estimated Population for the Year.
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
the Deaths.																							
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
the Population.																							

Graphic Representation.

When the succession of events or phenomena has been recorded during a long period, a vivid, almost intuitive apprehension of their varying numbers or intensity in relation to time may be attained by means of diagrams or graphic representation.

The usual and clearest method is that of two series of horizontal and vertical lines intersecting one another at right angles, the horizontal series of squares representing successive periods, and the vertical series the events or phenomena occurring in each. The former may be years, quarters, months, weeks, or in shorter periods of observation, even days; the latter numbers or degrees. The former are written off at the head and foot of the table; the latter, whether units, tens, or other numbers, in the margin, and these being marked by a dot in each square, a line connecting them indicates the course of the events in question. This line is called the curve of mortality, of sickness, of temperature, atmospheric pressure, rainfall, &c., as the case may be. The prevalence of several diseases during the same year may be shown in juxtaposition by using lines of different colours, or continuous, interrupted and dotted lines (Fig. 11). The mean may be a horizontal line intersecting the

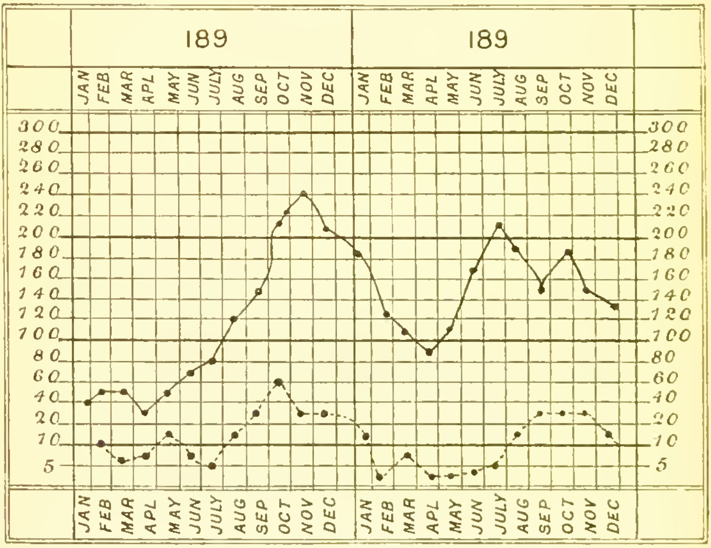
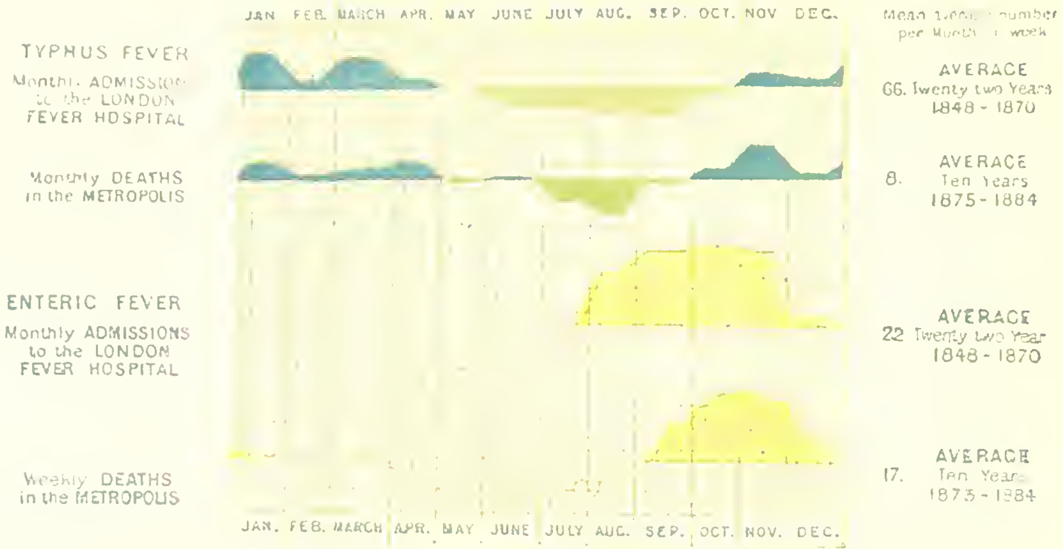


FIG. 11.

PLATE I.—DIAGRAM REPRESENTING MEAN AVERAGES, WITH WEEKLY PERCENTAGE OF EXCESS AND DEFICIT (pp. 86, 87).



The curves represent the percentage deviation above or below the mean of the average monthly or weekly admissions or deaths.
One small division of the vertical scale corresponds to 10 per cent.
The figures at the side give the actual means.

[To face p. 6.

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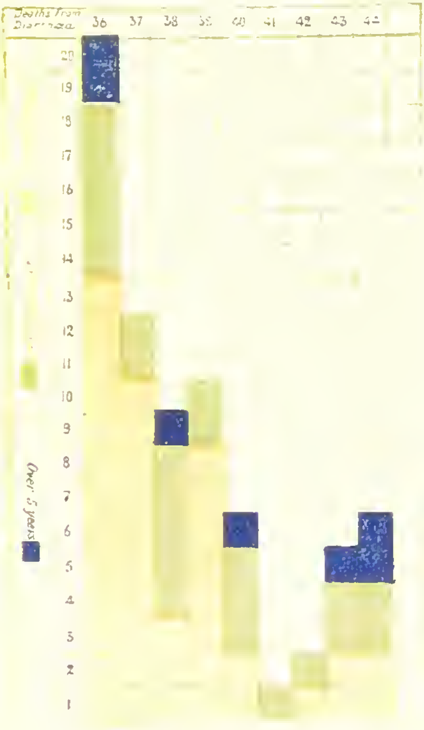
PLATE II.—DIAGRAM REPRESENTING DAILY RECORD OF DEATHS AT VARIOUS AGES DURING EPIDEMIC (p. 87).



[*To follow* PLATE I.

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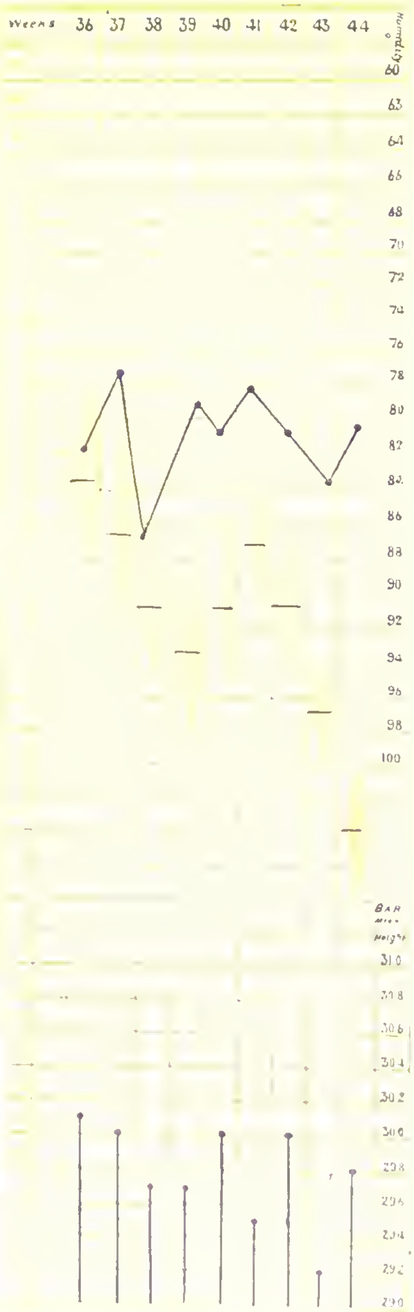

PLATE III.—DIAGRAM REPRESENTING ON A SINGLE SHEET DAILY SIMULTANEOUS OCCURRENCE OF VARIOUS PHENOMENA (p. 87).

[*To follow* PLATE II.

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curve at the proper height represented by the figures in the margin. In this arrangement all events are considered as positive, but excess and defect may be more vividly exhibited by marking one horizontal line at the mean of the whole period, and filling in with colour the spaces inclosed between it and the curves above and below (Plate I.). The actual numerical value of the mean is indicated in the margin against this line, and the squares superposed vertically above and below represent percentages, each usually ten per cent., above or below this mean, or average number.

A third method specially applicable to epidemics of short duration, in which the question of age is a matter of consideration, as in summer diarrhœa, and first suggested by Sir G. Buchanan, is highly instructive. In it the horizontal series of squares represent days, and the vertical sizes deaths; but the latter are distinguished according to age by colour: those of infants under one year being filled in with red, those of children between one year and five with blue, and those above five with black; the first, forming the great majority, are placed below, above these the second class, and the last, as the least numerous, at the summit of each column (Plate II.); and, fourthly, by making the vertical series represent more than one kind of phenomena; and by reckoning from above downwards, as well from below upwards, together with the use of different colours, several distinct series of meteorological observations may be exhibited on a single sheet. Thus Dr. Tatham in his reports indicated the weekly mean height of the barometer by black vertical lines with clubbed summits at the foot of the sheet, rainfall by similar lines, but blue and inverted from the top of the sheet, humidity by the usual curve or zigzag line, and the maximum and minimum temperatures by lozenge-shaped or fusiform red figures clubbed at the two points, with a black transverse line or bar in each to show the mean temperature of the week, which is not always the absolute mean of the extremes (Plate III.).

Some phenomena may, for different purposes, be contemplated either numerically or proportionally, *e. g.* epidemic diseases as to their actual prevalence in any one, or in consecutive years, or as to their relative incidence in successive months in each. For the former we use the ordinary graphic representation in which the horizontal lines indicate actual numbers, but for the latter Buchan and Mitchell's method, in which these represent the percentage above, or below the average of the particular year, irrespective of the actual numbers (Plate I).

IV. ENGINEERING MEMORANDA.

Hydraulic Memoranda and Formulæ.

1 *Cubic foot of Water* = 62·5 lbs. = 0·0278 ton = 6·25 or $6\frac{1}{4}$ gallons, and presses as 0·434 lb. on each square inch.

1 *Cylindrical foot* = 49 lbs. = 4·9 gallons, and presses as 0·34 or $\frac{1}{3}$ lb. on each circular inch.

1 *Gallon* = 10 lbs. = 0·16 = $\frac{4}{25}$ cubic foot.

1 *Ton* = 224 gallons = 35·9 cubic feet.

Let H = "head," or depth of water in feet.
,, h = ,, ,, ,, in inches.
and P = pressure in lbs. per square foot.
,, p = ,, ,, per square inch.
$P = H \times 62{\cdot}5$ lbs. $= h \times 5{\cdot}2$ lbs.
$p = H \times 0{\cdot}4335$ lb. $= h \times 0{\cdot}036$lb.

Sea water. 1 cubic foot = 64·25 lbs. = 0·0286 ton.
1 cylindrical foot weighs 50·462 lbs.

Capacity in gallons of cisterns (the dimensions given in feet):

Rectilinear $= h \times l \times w \times 6{\cdot}25$. (Each foot in depth of a cistern 40 ft. sq. = 10,000 gallons.)

Cylindrical $= h \times d^2 \times 4{\cdot}9$. (1,000,000 gallons = 160,000 cubic feet = 4464·285 tons.)

Rainfall in inches × 0·52 = gallons per sq. ft.; × 22,620 = gallons per acre; × 3630 = cubic feet per acre; × 2,323,200 = cubic feet in square mile.

The maximum rainfall must be the basis of calculations for drainage, and the minimum for water supply. These are as a rule 30 per cent. above and below the average, a small part only of the total being available for storage after allowing for absorption and evaporation, which depend on the nature of the soil.

"Hydraulic mean depth" of *curvilinear* channels means the depth of a *rectilinear* channel whose sectional area, and therefore the volume of whose current, equals that of the curvilinear channel under consideration. Thus if the line drawn from one bank of a river to the other along the *bottom* of the stream is 100 feet, the hydraulic mean depth is the depth of a rectangular channel 100 feet wide, which would have the same sectional area as the river and carry the same quantity of water. It is defined as "the sectional area divided by the wetted perimeter."

For circular pipes, whose diameter we may take as 1, running full, the sectional area will be the area of the circle $= \pi r^2$, and the wetted perimeter will be the circumference $= 2\pi r$; and for the same pipes running half full the halves of these or $\pi r^2 \div 2$ and $2\pi r \div 2$; thus in either case the hydraulic mean depth is one-fourth of the diameter of the pipe, for the

$$\frac{\text{Sectional area}}{\text{Wetted perimeter}} = \frac{\pi r^2}{2\pi r} \text{ or } \frac{\frac{\pi r^2}{2}}{\frac{2\pi r}{2}} = \frac{r}{2} = \frac{1}{4}$$

In other words, the depth of a rectangular channel corresponding to, and having a width equal to the wetted perimeter of a semi-circular one, will be one-half that of the latter, or one-fourth of the diameter of a circular one. For depths greater or less than a semi-circle, the arcs and segments to be added or subtracted can be determined only by trigonometrical methods, but are rarely required in practice.

Velocity and Delivery in Open Channels.

Neville's formula gives very nearly the mean velocity of rivers, the fall in feet per mile being easily ascertained and the hydraulic mean depth calculated from the determination of the sectional area and the width of the *bed* from bank to bank in several points of its course, according as the section is a segment of a circle or a trapezium.

v = velocity in feet per second.
r = hydraulic mean depth in feet.
s = sine of inclination or $\frac{\text{total fall}}{\text{total length}}$
(one mile = 5280 feet)

$$v = 140 \sqrt{rs} - 11 \sqrt[3]{rs}$$

If we represent the diameter in feet of a pipe by d, we may obtain from this formula its delivery per minute by multiplying v into $47{\cdot}124d^2$ for cubic feet, or into $293{\cdot}7236d^2$ for gallons.

The mean velocity of large or navigable rivers may be estimated by the following formulæ—

V = velocity at surface in inches per second.
Velocity at bottom = $(V + 1) - 2\sqrt{V}$.
Mean velocity = $(V + 0{\cdot}5) - \sqrt{V}$.
or in sluggish rivers = $0{\cdot}8\ V$.

The maximum velocity is usually that of the surface over the greatest depth; velocity at the bottom is retarded by friction.

If v = the mean, V = the maximum, and u = the velocity at the bottom,

$$v = V \frac{7{\cdot}783 + V}{10{\cdot}345 + V} = 0{\cdot}83\ V \text{ approximately.}$$

$$u = 2v - V = 0{\cdot}75\ v = 0{\cdot}62\ V \text{ approximately.}$$

Gauging flow of Rivers and Open Channels.

Discharge of water through a sluice.—Breadth × height of opening = sectional area. Discharge = sectional area × 5 × $\sqrt{\text{Head of water in feet}}$—the head being the difference of level of the water above and below the dam if the sluice be entirely under the lower level, or the height of the upper level above the centre of the opening if the sluice be above the lower level.

Discharge of Water over a Weir of 1 foot length.

Depth of Fall in Inches.	Discharge per minute in Cubic Feet.
½	1·70
1	4·82
1½	8·84
2	13·63
2½	19·70
3	26·62
3½	33·22
4	40·71

But in the absence of such conveniences a rude estimate may be made by multiplying the sectional area into four-fifths of the surface velocity, as determined by the motion of light floating bodies.

Velocity and Discharge in Open Channels.

Bazin's formula (modified) for estimating discharge of water in open channels constructed or formed of different materials—

V = mean velocity in feet per second.
D = hydraulic mean depth.
S = slope of channel or length to fall of 1 foot.
A = sectional area in square feet.
K = co-efficient for materials of channel and velocity of current.
Q = delivery or discharge per second in cubic feet.

$$V = \sqrt{\frac{DK}{S}} \qquad Q = AV.$$

Material of Channel.	Value of K for Velocities.	
	Under 4 feet per second.	Over 4 feet per second.
Brickwork	8,800	8,500
Earth	7,200	6,800
Shingle	6,400	5,900
Rough rock and boulders	5,300	4,700

In very large channels or rivers K = 8,500 to 9,000.

The rate of flow capable of lifting or carrying various solid bodies and matters is an important consideration in connection with the scouring of rivers and avoidance of deposits in sewers.

	Per second. Ft.	inches.
River mud, liquid earth, &c.	0	3
Common clay	0	6
Yellow loamy sand	0	9
Common river sand	1	0
Gravel from 4 inches to ... ... according to size of grains.	1	0

	Feet per second.
Shingle 1 to 2 inches in diameter ...	— 2 to 3
Angular stones, flints, &c.	— 3 to 4
Flaky rocks, slates, &c.	— 6 to 10

A river is sluggish when flowing—

1 mile per hour = 1·44 feet per second.
,, ordinarily swift 2 ,, ,, = 2·88 ,, ,,
,, very rapid 5 ,, ,, = 7·2 ,, ,,

Egg-shaped Sewers.

The egg shape is formed by two circles touching each other, such that the diameter of the upper equals twice that of the lower, the sides of the figure being completed by arcs drawn from points, as centres on each side, on a level with the centre of the upper and larger circle, and at a distance from the circumference of this circle equal to its radius, *i. e.* to the diameter of the smaller circle. (In practice this point is found to be slightly below the level indicated.) Thus this radius equals the sum of the diameters of the component circles, *i. e.* the depth of the sewer.

For practical mensuration the area is taken as that of an ellipse with semi-axes equal to the depth of the sewer and the diameter of the upper and larger circle, the lesser one being disregarded. The diameter of a circle being twice the radius or $2r$, and the ratio between the diameter and circumference as 1 : 3·1416 commonly expressed by π, and the two semi-axes of an ellipse being represented by a and b.

The circumference of a circle $= 2\pi r$
and its area $= \pi r^2$
The perimeter of an ellipse $= \pi (a + b)$ approximately,
and its area approximately $= \pi (ab)$
An arc of a circle subtending A°

$$= \frac{A}{180} \cdot \pi r$$

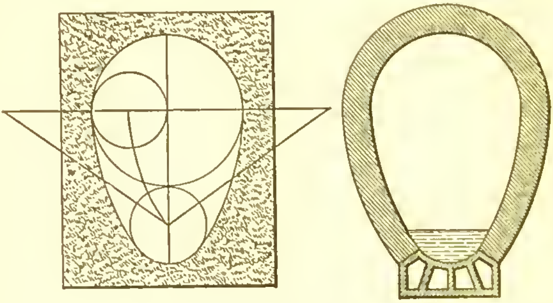
and the area of a circular segment

$$= \pi r^2 \cdot \frac{A}{360} - \frac{1}{2} r^2 \sin. A^\circ$$

A being the angle of the sector.

These last two formulæ are rarely required.

The form and construction of the egg-shaped or ovoid sewer are shown in the following figures.



FIGS. 12 and 13.

Thus if B = diameter of bottom of sewer, *i. e.* of small circle
C = diameter of top of sewer, *i. e.* of large circle
R = radius of sewer
D = depth of sewer

$$B = \frac{D}{3} \qquad C = \frac{2\,D}{3} \qquad R = D$$

The special advantage presented by this form is, that when the depth of the stream is diminished, the wetted perimeter, which is the friction-producing factor, is proportionately reduced instead of being, as in the circular and every other form, relatively increased.

Motion of Fluids in Pipes, &c.

A number of formulæ, based partly on scientific and partly on empirical data, are in use for calculating the capacity, fall, delivery of sewers, pipes, &c., and the velocity of the fluids therein. These factors being mutually interdependent, any one may be determined when the others are known. None of the formulæ can be deemed more than approximate, but the best is—

$V = 55 \sqrt{x \times 2f}$ and $Q = V \times A$, in which
x = hydraulic mean depth in feet.
f = fall in feet per mile.
V = velocity in feet per *minute.*
A = sectional area in square feet.
Q = cubic feet of water discharged per minute.
55 is an empirical constant.

Two useful formulæ (from J. T. Hurst) giving the discharge Q in cubic feet per minute, in which $\frac{f}{l} = \frac{\text{head of water}}{\text{length of sewer}}$ and d the diameter of a cylindrical sewer, or that of the larger circle in an ovoid sewer, are these

$$Q = 2100 \sqrt{\frac{d^5 f}{l}} \text{ for egg-shaped sewers}$$

$$= 1500 \sqrt{\frac{d^5 f}{l}} \text{ for cylindrical sewers.}$$

Mr. Blackwell's formulæ, in which allowance is made for ordinary friction, D being the diameter of pipe in feet, H = the fall in feet per mile, and V = velocity in feet per second, are

$$V = \frac{\sqrt{DH}}{2{\cdot}3}\,;\ D = \frac{2{\cdot}3\,V^2}{H}\,;\ H = \frac{2{\cdot}3V^2}{D}$$

Mr. Santo Crimp's formula is at once simple and accurate—

$$V = 124 \sqrt[3]{r^2} \sqrt{S}$$

r being hydraulic mean depth, and S sine of slant.

These formulæ apply to rectilinear channels or pipes, but when angles (knees) or bends are introduced into the course of a pipe, the increased friction calls for a greater head or pressure on the water.

If A = angle of bend or knee made with the forward direction of the water
V = velocity in feet per second
R = radius of centre line of bend
r = radius of bore of pipe

H = head of water required to overcome friction
K = co-efficient for angle of knee
L = co-efficient for curvature of bend

$$H = 0·0155\ V^2K \text{ for knees.}$$

$$H = 0·0155\ V^2 \left(\frac{A}{180} L\right) \text{ for bends.}$$

The value of K for several angles is

A° =	20°	40°	60°	80°	90°	100°	120°
K =	·046	·139	·364	·74	·98	1·26	1·86

The value of L depends on the ratio of the radius of the bend to the radius of the bore, and differs as the section of the channel is circular or rectangular, thus—

When $\frac{r}{R}$ =	·1	·2	·3	·4	·5	·6	·7	·8	·9	1·0
In circular sections L =	·131	·138	·158	·206	·294	·44	·66	·98	1·4	2·0
In rectangular sections L =	·124	·136	·180	·25	·4	·64	1·01	1·55	2·3	3·2

Regulation of Velocity in Sewers.

The velocity of the flow in sewers and drains should never be less than 2 or 3 feet per second, nor in brick sewers more than 4 or 5, for if there be much sand or grit in the sewage a velocity of 6 feet is apt to wear away the brickwork. As a rule, the relation between size and velocity may be thus stated.

Over 36	inches	diameter	2½	feet	per second	= 150	per minute.
18—36	,,	,,	3	,,	,,	= 180	,,
6—18	,,	,,	3½	,,	,,	= 200	,,
Under 6	,,	,,	4	,,	,,	= 240	,,

Fall of Sewers and Drains.

The fall in sewers should be about 1 in 240 as a rule, though with frequent flushing 1 in 600 may be permitted when it is impossible to obtain a greater. When it is less than this deposits must occur, removable only by manual labour, and such practical dead-levels as 1 in 3000 to 6000 are a disgrace to engineering.

House drains should have greater gradients than sewers.

1 in 40 is good for a 4 inch drain.
1 in 60 ,, ,, 6 ,,
1 in 80 ,, ,, 9 ,,
1 in 10 for gutters in roofs, &c.

Size of House Drains.

They should not be too large. A 4 inch pipe is large enough for most houses, 6 in. for a hotel or mansion, and 9 in. for the most extensive establishments, as hospitals or workhouses.

Mr. Julius Adams, City Engineer of Brooklyn, who has had extensive experience of both the combined and the separate systems, very rightly insists on the greater fall requisite to keep the combined sewer free from deposits in consequence of the fluctuations in the volume and nature of the sewage.

When a sewer runs half full 2·5 feet per second suffices to render it self-cleansing, but to obtain this velocity in a combined sewer at its lowest ebb, such a gradient is necessary as shall give the needless rate of 3·75 feet when it is half full. Thus the gradients proper to circular pipes to ensure a velocity under *all* circumstances of 2·5 feet per second should be.

Diam. of Sewer in Inches.	Combined System. Fall of	Separate System. Fall of
6	1 in 60	1 in 150
9	,, 90	,, 248
12	,, 200	,, 350
15	,, 250	,, 458
18	,, 300	,, 570
24	,, 400	,, 805
36	,, 600	,, 1309
42	,, 700	,, 1575
48	,, 800	,, 1849

It is the presence of sand, road-grit, &c. in the sewage that necessitates a higher gradient and velocity in combined sewers, than in those in which the sewage is free from extraneous matters, and constant in volume.

Pumping Stations and Ejectors.

When the uniformity of level over a wide extent is such that gradients steep enough to render the sewers self-cleansing cannot be obtained the sewers should be laid in successive lengths, each with a proper fall, and the sewage be lifted from one to the other mechanically; if the intervals between the pumping-stations be so great that the fall is still insufficient, considerable deposits of silt and foul mud will occur demanding manual labour for their removal.

The Shone system, in which any number of ejectors, acting by means of compressed air, can be worked from a single central steam engine presents obvious advantages. It is not that compressed air is less expensive than the ordinary steam pump, but that the cost of each ejector being small, and their action automatic, one engine sufficing to work a number of ejectors, the sewers may be divided into numerous sections each having an ample fall, so as to employ the aid of gravitation with the utmost advantage. Two ejectors with capacities of 100 gallons, each capable of raising 75 gallons of sewage 50 or 60 feet, equal to the sewage and maximum rainfall of an area with 2000 inhabitants, together with the station, could be put up for £450 or £500, while the coal consumption would not exceed 1*s.* 6*d.* per diem, and the cost of attendance would scarcely exceed that required for cleansing common gravitation sewers with low gradients. The more numerous the ejectors the less the working expenses per 1000 population. If small bore pipes on the separate system be employed, the lowest points of the short sections, just above each ejector, need not be at a greater depth than 14 feet from the surface, reducing the cost of excavation. The cost per head of the Shone system has been found to vary between £3 and £3 15*s.*; that at Wallingford, where alone it is carried out completely, having been £3 9*s.*, whereas ordinary gravitation sewerage costs £5 to £7, and with hydraulic pumping applied to the same, as at Margate, £4 7*s.*

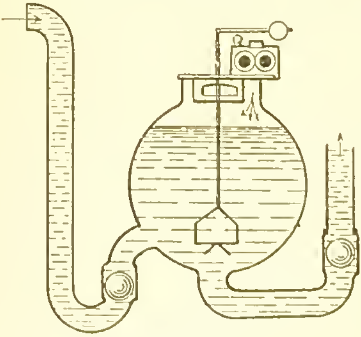


FIG. 14.

The ejector (Fig. 14) is a horizontal cylindrical reservoir, erected in a vault beneath the roadway or other ground level, the pipe sewers entering and leaving it being furnished with inlet and outlet ball valves, and the former having the form of a syphon. The compressed air tubes are conducted along the upper flat outer surface of the reservoir. When the sewage has risen to the top of the reservoir, it acts by means of a float on a counterpoised lever, which opens a valve admitting the compressed air, which, closing the inlet ball valve while it raises the other through the pressure on the fluid, rapidly and forcibly ejects the whole of the sewage into the further length of pipe sewer, the sinking of the float then closes the valve of the compressed air tube, at the same time opening another for the escape of the now expanded air until the sewage again fills the ejector. Alone or combined with automatic flushing it is well adapted for use in large establishments, as hospitals, the drains of which are more or less complicated and perhaps connected with unsatisfactory sewers.

Flushing of House Drains.

Much misconception exists on this point. By flushing is meant a discharge of water such that the pipe or drain shall *run full* for a certain time. No leaving taps open or holding up of closet handles will flush a drain ; such attempts are a useless waste. A single pail emptied suddenly will flush more effectually than a cistern full run off slowly ; and the merit of drains of small calibre, as we have recommended, is that they are flushed by a smaller volume of water. If the fall be sufficient, and solid bodies likely to cause stoppages are not allowed to find their way into the drain, flushing is rarely called for ; but where an adequate fall cannot be obtained flushing tanks are advisable.

Flushing tanks are of various kinds, some being automatic, *i. e.* discharging themselves when full. The type of these is that of Mr. Rogers Field. Its principle, which is that of an annular syphon depending for its action on the peculiar form of the lip of the inner tube, is ingenious and simple. It may be fed by any small waste, as that of a drinking fountain, and when full it rapidly discharges the whole of its contents.

Small flushing tanks may be fixed at the head of the system of drains in large houses and establishments, and larger ones holding 150 to 250 gallons at the dead ends of the public sewers, especially in the separate system, when 150 gallons will form a solid cylinder of water for a length of 60 feet of an 8 inch, or 110 feet of a 6 inch, pipe drain carrying everything before it.

SEWERAGE SYSTEM AND WORKS.

Volume of Sewage.

Whatever its nature and composition, the sewage of a town as regards quantity consists of (1) the water supply which, whether used for drinking, washing, or other purposes, is returned in a fouled state as sewage, and (2) that portion of the rainfall which is passed into the sewers. In towns sewered on the separate system only the rainfall on roofs and curtilages is added to the sewage, the volume of which is practically a constant and known quantity, but the addition of surface and storm waters from the streets introduces an element of uncertainty and great fluctuations in the volumes to be dealt with by the authority.

Composition of Sewage.

An adult man passes daily 3 to 4 oz. of fæces, and 40 to 50 oz. of urine, women and children somewhat less, so that for a mixed population 2½ lbs. of excreta, comprising 2½ oz. of fæces and 30 to 40 oz. of urine, may be taken as a fair daily average, of which about 300 grains are insoluble in water.

Lawes and Gilbert estimate the fresh fæces of an adult man at 4·17 oz., and the urine at 50·18, but the latter varies much in its volume. When dried the fæces weigh 1·041 oz., and the urine evaporated leaves a residue of 1·735. Thus the total solids excreted = 2·776 oz., and the water 51·574. The urine contains actually more solids than the fæces, while their manurial value is six times as great. Earth closets which let these waste are economically an error. Sewage varies greatly in composition. For those of Leeds and Salford, see p. 158.

The average amount of solids in sewage may be taken at 90 grains per gallon, of which 28 are organic and 62 inorganic; or in parts per million,—organic 4,004, and inorganic 8,866.

Prof. Williamson, in Sept. 1877, made the following complete analysis of London sewage at the northern outfall :—

		One hour before low water.		Two hours after high water.	
		Grains per gallon.	Parts per million.	Grains per gallon.	Parts per million.
Suspended Matters		108·01	1544·54	151·50	2166·45
Organic matter		37·24	532·53	104·97	1501·07
Sand		44·10	630·63	23·52	336·336
Iron		4·90	70·07	1·96	28·028
Alumina		4·90	70·07	8·40	120·12
Carbonate of lime		12·07	172·60	11·20	160·16
Oxygen and iron combined with other matters undetermined		4·80	68·64	1·45	20·735
Dissolved Matters		81·00	1158·3	103·60	1481·48
Chlorine		26·65	371·09	31·48	440·164
Albumenoid ammonia	In suspended and dissolved matter	4·13	59·06	4·09	58·487
Ammonia free		2·46	34·178	4·55	65·065

Pails and Earth Closets.

Water-closets and sewers are nowadays taken as evidence of higher civilisation and refinement, but though nothing could be worse than the rural privy pit, the common midden in a Yorkshire town, or the "tonneau" in the cellar of a French house, I must, at the risk of being deemed retrograde, protest against the tendency to construct costly sewerage works in villages and small towns, fouling the river and robbing the land of its due. Disgusting as are the middens and pails of our northern towns, the mortality from typhoid is lower in Oldham, Bradford, &c., than in the w.c. towns of Liverpool and Birkenhead. But, to say nothing of experiments, as that of Dr. G. V. Poore at Andover, there is the example of Holland, where sewers being precluded by physical conditions, all excreta are applied to the land, much of it poor sand reclaimed from the sea or drained morass, with the result that a denser population than ours thrives on agriculture, exporting enormous quantities of dairy produce, while the towns can show general and typhoid death-rates lower than ours, and steadily falling year by year, and the cleanliness of the houses and the scavenging of the streets exceeds anything to be seen elsewhere, the whole administration presenting a model at any rate for towns with not more than 10 to 20,000 inhabitants.

REMOVAL OF SEWAGE.

Combined and Separate Systems.

When a sanitary authority undertakes the sewerage of a town, the choice must be made between (1) the combined or (2) the separate system. In the former the sewers are constructed to carry the rain as well as the sewage, and the simplicity or, more correctly, the unity of the system is claimed as a recommendation. It is often alleged that sewers drain the subsoil, and a number of towns in which sewerage works have been followed by a fall in the ground water and diminution of phthisis, are appealed to as evidence. But this is an error: water-tight or impervious sewers do not drain the subsoil; a sewer which does admit water from without will, when the pressure is reversed, allow the outward passage of sewage. Sewers are best made with specially designed bricks, wedge-shaped not rectangular in section, hard or vitrified, laid in concrete and lined with cement. The removal of the ground water must be provided for by pervious earthenware pipes laid alongside the sewer or by the hollow perforated stoneware inverts made for the purpose.

The disadvantages of the combined system are, that while the sewage is a constant and known quantity, being practically equal to the water supply, and varying only with the hour of the day ; the rainfall is inconstant and varies widely with the season and between different years. Such sewers, if made large enough to carry off the heaviest thunder shower, present during droughts a shallow sluggish stream, and are apt to permit deposits of solid matters which putrefy and evolve "sewer gases," which, as Pettenkofer very properly insists, must be distinguished from "sewer air." If too small, the sewage, swollen by storm waters, "backs" into the house drains, and may rise into the basements or even burst the sewer, as not unfrequently occurs in London. The first objection is to some extent obviated by the egg-shaped section, universally adopted in this country, Germany, and Italy, which gives with every variation of volume the maximum depth and the minimum of perimeter and consequent friction, and the latter by intercepting sewers following the contour lines of elevation and by storm overflows. These are usually carried direct to the nearest river, it being assumed that the dilution of the sewage renders it nearly harmless ; but this is not always so, for the quantity of street scouring carried through the gulleys makes up for the additional volume of water.

The separate system of sewers and drains consists of (1) iron pipes 6″ to 9″ in diameter, for the sewage and rainfall on roofs and in yards, &c., and (2) brick or earthen drains for street and storm waters. Such drains need not be impervious, may aid in drying the subsoil and lowering the ground water, and where old-fashioned defective brick or barrel drains exist they may be utilized. The street gutters should be well made and paved, and provided with gulleys to intercept grit, dung, sticks and rubbish from the street ; while these gutters should, wherever the inclination of the land permits, be connected with larger covered or open channels by which storm waters may be conducted to the nearest natural water-course.

At the head or dead end of each pipe drain or system of pipe drains an automatic flushing tank should be fixed capable of rapidly discharging 100 or 150 gallons at regulated intervals, by which the entire sewer may be thoroughly scoured three, four, or more times a day. Ventilating shafts should be fixed at suitable points, though deposits being impossible "sewer gases" are not generated. The greater expense supposed to be inseparable from a double system is imaginary, for while iron pipes are comparatively inexpensive, and if well coated with Angus Smith's solution are fairly durable, the cost of the rougher drains is so much less than that of properly made sewers with carefully regulated falls that the total expenditure on the two separate systems has been proved to be far below that of the combined.

SEWAGE DISPOSAL.

Whichever system of removal be in existence or be adopted, the question of sewage disposal will arise. The possible alternatives are—

1. Discharge of crude sewage into (*a*) the sea, (*b*) tidal, and (*c*) running rivers. 2. Its discharge into any of these after (*a*) coarse straining, subsidence, and filtration or (*b*) chemical treatment, and in either case the disposal of the sludge. And 3. The utilization of the crude or roughly-strained sewage by irrigation on land.

Into the Sea.

The Local Government Board has condemned the discharge of crude sewage into rivers but permits it into the sea, "provided no nuisance is caused thereby." The conditions, however, under which this can be done without nuisance are rarely to be found. It is not enough to carry the outfall far beyond low water mark, for—apart from the fact that the rising tide backs the sewage in the culverts or pipes, forcing the foul gases or even the sewage itself into the houses, unless by means of flaps or sluices this is prevented, when the flow is of necessity arrested for half of every twenty-four hours, to obviate which the sewage is stored in intercepting tanks, whereby fresh difficulties and nuisances are created—the conditions of ocean currents and the physical and chemical characters of sea water must be taken into account. It will mostly be found that, dependent primarily on the ebb and flow, but variously modified by geographical and local circumstances, there is a regular succession of currents in opposite directions alternating with intervals of rest. The effect of these, combined with the action of salt water on the sewage in arresting the oscillatory movements of the suspended particles, coagulating the organic matter and causing it to cohere with the mineral, is to form viscid or slimy masses which rise and float to and fro with the tide until they are deposited in still waters or along the foreshores, either near or at considerable distances along the coast, as may be seen at most of our seaside resorts.

Into Rivers.

The same invariably occurs in tidal rivers and estuaries, where banks of foul mud are raised, giving off noxious exhalations at low water. With running streams the progress is of course always in the same direction, and if the volume of the river be great and the current strong, as in the case of the Rhine, the sewage may not be deposited, and may undergo complete oxidation and resolution into inorganic compounds. But there is no such river in this country, and self-purification is a complex process, comprising dilution by affluents and by springs in the river-bed, oxidation and the action of animal and vegetable life, and of low organisms, under the most favourable circumstances very imperfect, and otherwise inappreciable. Dissolved matters constitute the chief value of sewage as a fertilizer, and by their subsequent putrefaction a nuisance and a danger. Effluents at first clean and inodorous may soon become foul and dangerous in rivers.

Methods for Chemical Treatment.

All chemical processes are wrong in principle, being opposed to the economy of Nature, and aiming at the unattainable; even in the "Ferrozone," there is no evidence of the "polarite" being other than inert, and what apparent success has attended it, is doubtless due to its having acted in the same way as the coke or limestone in the methods about to be described.

The quality of the effluent is greatly dependent on the previous state of dilution of the sewage, and the manurial value of the products on the chemicals added.

Bacterial (or Biological) Methods.

The researches of Schlössing, Wollny, and Muntz on the nitrification of organic matter in the soil by bacteria requiring air (aërobes), and those of Scott-Moncrieff and Dibden on the peptonization and reduction to the soluble form of solid and suspended organic matter, rendering it easily susceptible of nitrification, this change being effected by bacteria thriving in the absence of air (anaërobes), have not only explained Nature's mode of resolving organic matter into its inorganic elements, but have shown that by cultivating anaërobes under artificial conditions it is possible to obtain the complete solution of the solid organic matters that constitute the worst part of the sludge in as many hours as days or weeks would be required under natural conditions, though no filter is equal to the "living" earth for the nitrification of organic matter when in solution. Whenever land is not available for irrigation, a Sanitary Authority should adopt one or other of the Bacterial processes, or a combination of the two.

The Bacterial Filter.

The sewage having passed through a coarse screen and a small detritus tank, and into a larger one, where it is held up for twelve hours for the subsidence of mineral particles, is run into the coarse filters of coke breeze, clinker, limestone, hard-burnt ballast, or any porous material easiest obtained, in pieces 1½" to 1″ diameter. After 8—12 hours it is transferred to the fine filters, of similar construction but wider and shallower, for greater exposure to the air, the materials being screened to under 1″, but not less than ¼ inch diameter. Here it is kept for 3—4 hours, or better still, passed through several filters, remaining one hour in each. The action of the deep coarse filter is peptonizing, that of the shallower and finer is nitrifying; the effluent from the first containing scarcely any free oxygen or nitrates, while that from the latter is rich in both, especially in nitrates, evidence of the complete oxidation of the organic matter.

The Bacterial (or Septic) Tank.

When dilute sewage is left to rest in a closed tank the suspended organic matters rise to the surface, but the scum does not increase in thickness, for the solid albumenoid matters are continuously undergoing solution through the peptonizing action of *anaërobic* bacteria, and the liquid becomes so much the richer in dissolved organic matter, though, if drawn off without disturbance of the scum, the mineral particles having already subsided, it is almost free from turbidity or odour, and the nitrogenous matters are in a state peculiarly favourable for nitrification by the *aërobic* bacteria in open filters or the soil.

This procedure, long familiar to gardeners in country mansions, has recently been applied to the treatment of the sewage of towns, the first experiments having been carried out at Exeter by Mr. Cameron. The sewage after coarse straining by a screen is allowed to flow at the rate of 2½ feet an hour through an oblong covered tank capable of holding the delivery of 24 hours. At a distance of about one-sixth of its length from the inlet, a transverse submerged wall, rising to 2 feet below the surface of the liquid, divides off a compartment in which the heavier particles, as road drift, are deposited as sludge, which is removed from time to time; the fluid leaving the tank by a horizontal outlet extending across the entire width of the tank, and 18 inches below the surface of the liquid so as not to disturb the scum. Being now devoid of oxygen it is aërated by falling in a cascade from a trough into the channel by which it is conveyed to the irrigation fields, or, if sufficient land be not available for the purpose, and it must be discharged into a river, to the nitrifying beds or "filters" for previous purification. These, which are arranged in series of six, are filled with graduated limestone, gravel, and coke breeze, but though allowed to rest for aëration for 4 to 6 hours twice in the 24, are less active than the "living earth," and a final treatment on the land should never, if possible, be dispensed with.

Irrigation.

I have not the least hesitation in stating that the treatment and to some extent *utilization* of sewage by irrigation is that which a Sanitary Authority should adopt, if by any possible means it can be carried out. Land must be available of course, and light loams are the best for the purpose; chalk is good and improves by time; pure sand is at first inert, but if more or less of the suspended matters and sludge be incorporated with it, so that the sand becomes converted into soil, it is soon second to none as a purifier and source of profit. Stiff, heavy clays alone are absolutely unsuitable, but even these may be made fit for the purpose by burning and admixture with sand, chalk and ashes.

Irrigation is not mere filtration, but involves the removal and retention of the ammonia into which all organic matters are resolved, and which the organisms present in the superficial layers of all soils (except pure sand or clay) convert into nitric acid, which then combines with the lime, magnesia, and other bases in the soil to form salts, which with ammonia, phosphates, sulphates, &c., constitute the food of plants so far as derived from the soil, their carbon being drawn almost wholly from the air. The presence of vegetation to appropriate these salts as fast as formed is necessary, otherwise they will pass away with the effluents, or be washed downwards into the ground water, as happens with large dressings of chemical manures, but is not a matter of much sanitary importance. The same loss occurs when the sewage is applied in larger quantities than the vegetation can assimilate, the solubility of the salts preventing their accumulation in the soil, as seen in the case of the Craigentinny meadows near Edinburgh, which remain nearly pure sand after many years of continuous irrigation. When, as at Genvilliers near Paris, or Dr. Poore's garden at Andover, crude excreta are applied to the soil its fertility is greatly enhanced; and provided always that such manure is dug in, or deposited in trenches to be covered in day by day, this is the best mode of disposing of excreta in villages and rural homesteads, but is not a question for the consideration of urban authorities.

"Sewage farming" is a misleading expression suggestive of a lucrative speculation. It is true that certain agricultural operations are involved in the idea of irrigation, but the process is essentially and primarily the *purification of sewage* by passing it over and through land covered with growing crops, and these are but means to an end, viz the removal of impurities so as to produce an effluent that may safely be discharged into a river. The expenditure should be looked on as the cost of a sanitary procedure, and the profits if any merely as a set-off.

The best example of the disposal of the sewage of large towns by irrigation is at Berlin, a visit to which should be undertaken by all sanitary authorities contemplating its adoption. The "radial" system, as the engineer Mr. Hobrecht calls it, of dividing the sewerage system of the city into a number of independent sections, from each of which the sewage is conveyed by a separate culvert to one or other of the farms, presents many advantages.

Cereals should rarely, except during droughts, be irrigated while growing. Root crops, on the other hand, benefit by irrigation, and natural pasture still more. Where large volumes of water have to be disposed of Italian rye-grass is the best, its power of absorption being enormous, but it is only available for cutting as green fodder.

No unnecessary outlay on works should be allowed: the main channels or *carriers* must be laid in concrete, but all secondary trenches or *feeders* may be made by the plough or spade. The former should have a fall of 1 in 400, the latter of 1 in 300. The land having been chosen should be variously laid out in terraces alternating with gently inclined planes, and water-meadows for the final purification of the effluents from the irrigation fields.

The soil must be well worked and drained by porous pipes laid at a depth of not more than 6 or less than 2 feet. Nitrification is always most active in the first yard from the surface and is practically lost below the second; if the effluent be run over water-meadows the purification will generally be sufficient.

The land must never be water-logged, *i. e.* each charge of sewage must be allowed to pass entirely through the soil and out from the drains before another is turned on, so that air may thoroughly penetrate the interstices of the soil in the intervals. These intervals must be regulated by the nature of the soil and the humidity of the atmosphere at the time. On loose soils and in hot dry weather three charges may be practicable in a day; under other conditions one daily, or even one only every second or third day.

Frost and snow need not wholly suspend irrigation, for the higher temperature of the sewage will as a rule thaw the ground so as to permit of percolation.

On every ground it cannot be too strongly insisted on that as much land as possible should be secured. If not required it may be let to the neighbouring farmers, but a false economy of taking up no more than is absolutely necessary may lead to complete failure, or at least to dangerous interruptions. The disposal of the sludge is always difficult, its manurial value being little or none, but it is very useful for rapidly filling up and raising low-lying tracts of sand reclaimed from the sea, and it may be ploughed into poor and very light lands without detriment, or if it contain much clayey matter, with benefit to sandy and chalky soils, especially if the lighter suspended matter and the water be also applied.

Disposal of Sludge.

Sludge from catchment-tanks—the refuse paper, sticks, stones, &c., having been previously intercepted by coarse straining—consists at first of 90 per cent. water, and 10 per cent. solids, from 20 per cent. to 60 per cent. of the latter, or 33 per cent. on an average, being organic. If lime has been used as a precipitant it has the largest bulk and the least value, while sulphate of ammonia gives the opposite result. The sulphate is itself a fertilizer, it fixes the phosphoric acid and adds very little to its bulk. Mere draining will not reduce the water to less than 80 per cent. after 48 hours, or 70 per cent. after a week. Exposure in thin layers on well-drained soil, or drying in presses, will reduce it to 50 per cent., and aided by artificial heat to 15 per cent. The absence of offensive sludge consequent on the complete solution of all organic matter is a great merit of the Bacterial treatment of sewage.

WATER SUPPLY AND WATER WORKS.

Quantity of Water Required.

Estimates based on the quantity required by each individual are useful, and indeed necessary in determining the supply to be provided for large private or public establishments, which should be not less than 25 gallons per head for personal use, or 30 if laundry work be done in the premises, nor under any circumstances less than 40 in hospitals. Horses require 6 to 10 gallons for drink, and 3 or 4 for washing, *i. e.* 10 to 15 gallons per head.

A rough estimate for towns, allowing for baths, closets, and unavoidable waste, gives 25 gallons per head with 5 for municipal use, street-watering, fires, &c., and 5 to 10 for trade purposes in manufacturing towns, or 30 to 40 gallons per head on the population. The public supply in different towns in Great Britain varies from 12 in Norwich to 50 in Glasgow. The London Companies supply on an average 22 to 34 gallons, but in many of the poorer quarters the actual allowance is under 10. In Venice and in New York it is as much as 300, or practically unlimited. It should therefore not be less than 30, nor need it exceed 60.

If the cost of a really pure water be so great as to suggest a restriction of the supply, 20 gallons per head of the pure water (or 25 if possible) should be laid on to the houses, and an inferior water reserved for municipal and manufacturing purposes (brewing, &c., excepted), indeed, sea-water may always be used with great advantage for streets and fire extinction, but on no account should two qualities be supplied to private houses.

Sources of Water Supply.

The rainfall is the ultimate source of all water, whether it be collected before or after percolation into the earth. But practically the sources may be considered as—

1. The rainfall on mountains and moorlands collected in natural lakes or artificial catchment reservoirs. 2. Rivers. 3. Wells and springs; and 4. On a small scale rain-water gathered from roofs or paved ground.

The first source is one of the best and purest, the only objection being the occasional presence of small quantities of cow-dung and of peat-staining which causes the water to act on lead pipes. Rivers are not as a rule safe sources of supply, since in a thickly-peopled country they are all more or less polluted with the sewage of towns, of scattered dwellings, and of the floating population, as well as with factory wastes and the drainage of cultivated and manured lands. The outbreak of typhoid fever at Gloucester, following its prevalence at Kidderminster, shows the danger incident to the use of even so large and rapid a river as the Severn. But rivers impounded near their sources, when this can be done to an adequate extent, and the source is in an upland uninhabited or moorland district, are equal in purity with mountain lakes. Lakes and ponds in low and cultivated countries are even more objectionable than rivers. Wells and springs differ greatly. Springs rising on high and especially bare hills, and deep wells, *i.e.* wells fed from water-bearing strata from which surface drainage is shut off by a superincumbent impervious bed, are the best sources where mountain lakes are not available. The purest waters are those yielded by the granite, slate, Devonian, and mountain limestones and the coal measures in the north and west of Great Britain, and by the oolite and chalk in the midland, southern, and eastern counties. The only objection to limestone and chalk waters is their hardness. Dolomitic waters are believed to induce goitre, though this has not been borne out by the experience of Sunderland, and the springs in the lias are generally highly charged with chlorides and sulphates, indeed the so-called "mineral" or medicinal waters belong for the most part to this class. The coloured tertiary sands act powerfully on lead, zinc, and other metals, but otherwise these beds give very good water. Shallow wells are always liable to pollution unless far removed from all possible sources of contamination.

Estimation of Rainfall.

Determine the mean rainfall, the maximum and the minimum, the former being the basis of calculation for drainage works, the latter for water supply. The extremes are as a rule one-third above or below the mean.

The rainfall in inches—

× 0·52 = gallons per square foot.
× 22620 = ,, per acre.
× 14·5 = million gallons per square mile.
× 3630 = cubic feet per acre.
× 2323200 = ,, ,, per square mile.

In calculating tho quantity to be obtained by collecting the rain from a roof, take the ground area of the building, ignoring tho additional area of the roof due to its slant.

In all estimates an allowance must be made for loss by evaporation, both before and after collection, and in collecting water from all areas, except roofs, for the loss by percolation, which varies with permeability of the soil from about 20 to 80 per cent.

The total rainfall varies in the North and West between 30 and 75 inches, in the East between 17 and 35, but only a fraction of this is available. Yet 12 inches collected in the year on one acre will provide 25 gallons daily to thirty persons, a fact to be borne in mind by the local authorities in rural districts.

Storage.

The water if obtained by catchment or pumped from rivers should be kept for some days nearly quiescent to allow of the subsidence of suspended particles in reservoirs holding at least a week's supply, the sides faced with concrete and the beds the same or puddled. Fish and the higher water plants are rather an advantage than not.

Too much reliance is often placed on the so-called self-purification of rivers, which is not a spontaneous process of oxidation, but the result of the combined action of animal and vegetable life of every grade, requiring as a necessary condition a certain degree of purity and presence of free oxygen, either initial or acquired through subsequent dilution with springs or purer affluents, permitting of the growth of vegetation and healthy animal life.

Constant and Intermittent Service.

Constant service does not altogether dispense with cisterns. They are required for the w.c.'s, and are still advisable as a provision against interruption or other emergencies. But the taps for drinking water, and in the houses of the poor those for *all* purposes, should be in direct connection with the service pipe or "rising main." In very poor quarters public hydrants would be preferable. Waste is to be prevented, not by narrow throttles, &c., but by sound fittings, tell-tales, and supervision.

Wells.

Dug wells should be soundly lined with cement while passing through any pervious strata above that from which the supply is drawn, and the masonry should always be raised some two feet above the surrounding ground level (which should also be paved), and "domed," the aperture being closed by a stone slab. The masonry should in loose soils be backed also with concrete or puddle.

In villages where shallow wells are sunk in gravel and other loose soils, an inexpensive and perfectly impervious lining may be made by letting down sections of the largest stoneware pipes used for street sewers, the joints carefully made with cement. Pumps should be substituted everywhere for the bucket and windlass, with which fouling is inevitable.

Cost of Well-Sinking.—Mr. Docwra estimates the cost of sinking wells in the soft chalk, the well having a diameter of 7 feet, at 20*s.* per foot for the first 20 feet, and 5*s.* per foot more for each additional 20 feet, thus—20 to 40 feet deep, 25*s.* per foot; 40 to 60 feet deep, 30*s.* per foot. In driving headings the cost depends on the depth from the surface: one at 100 feet deep, 7 feet by 4 feet, costs about £2 to £3 per foot of length in the soft chalk. It is, however, only where headings and adits must be driven that any part of a well need be dug.

Bored and Driven Tube Wells.

For depths under 50 feet in loose soils the simple driven tube, or Abyssinian well, is much cheaper and safer than the dug well; while for deep wells, the greater the depth and the harder the rock the greater the economy of boring. If the supply be insufficient, other wells may be bored or driven in the vicinity, and connected with the same pump at less cost than driving headings.

Cost of Boring (3—12 in.) *exclusive of Tubes, per foot.*

Depth.	Soft soils.	Hard rocks.	Cost of Tubes per foot.	
Under 100 ft.	3*s.*—20*s.*	20*s.*—40*s.*	3 in... 4*s.*	¼ in. thick.
100—200 ,,	13*s.*—30*s.*	25*s.*—50*s.*	4 in... 5*s.*	
200—300 ,,	18*s.*—40*s.*	30*s.*—60*s.*	6 in...10*s.*	⅓ in. thick.
300—400 ,,	23*s.*—50*s.*	35*s.*—70*s.*	10 in...20*s.*	
400—500 ,,	28*s.*—60*s.*	40*s.*—80*s.*	11½ in...25*s.*	

Cost of Driven Tube (1½—3 in.) *Wells inclusive* (Isler).

Depth	Inner Diameter of Tube			Depth.	Inner Diameter of Tube		
	1½ in.	2 in.	3 in.		1½ in.	2 in.	3 in.
Feet.	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*	Feet.	£ *s.* *d.*	£ *s.* *d.*	£ *s.* *d.*
12	2 3 6	4 0 0	7 10 0	30	4 14 6	8 10 0	16 10 0
15	2 12 0	4 15 0	9 0 0	36	5 11 6	10 0 0	19 10 0
18	3 0 6	5 10 0	10 10 0	40	6 2 10	11 0 0	21 10 0
24	3 17 6	7 0 0	13 10 0	Each ft. deeper	2 10	5 0	10 0

Pipes of these three bores will deliver respectively 150—900, 300—1500, and 450—3000 gallons per hour according to the pressure, &c.

The tubes should be left in, except in hard rock. The yield may often be greatly augmented by the explosion of a Nobel's gelatine cartridge low down in the boring, producing fissures in every direction.

In deep wells Bacon's pneumatic pump, worked by compressed air, presents great advantages. The pipes are double, an inner and an outer, but there is no machinery in the well to break down.

The Hydraulic Ram.

In country houses a clear stream or lake sometimes offers a more convenient source of water supply, and if a fall of three feet or more can be obtained, the Hydraulic Ram furnishes a means of raising the water to heights determined by the fall, and the proportion of the water passing through it required for the service. It works automatically and ceaselessly by the compression and expansion of the contained air, unless the water freeze.

Up to 800 feet $\frac{1}{7}$ of the water can be raised to four times the height of the fall, $\frac{1}{14}$ to eight times, $\frac{1}{28}$ to sixteen times, and so on, though when the distance is great, allowance must be made for friction in the pipes.

V. SANITARY PRACTICE.[1]

The Medical Officer of Health.

Appointment, tenure of office, duties, &c., are regulated by § 191 of the P.H.A., and § 108 P.H.(L.)A., also by circulars and general orders, especially Nos. 5, 6, 7, 8, and 29, 1880, and as regards London that of Dec. 8, 1891, from which the following abstract is taken.

Art. 18. *Duties of M.O.H.*

(1) To inform himself of all influences affecting or threatening to affect injuriously the public health in his district.

(2) To inquire into the causes, origin, and distribution of diseases therein, and how far dependent on preventible causes.

(3) By systematic and special inspections to keep himself informed of all conditions injurious or dangerous to health.

(4) To advise the S.A. on all matters affecting the health of their district, and sanitary points involved in their action. Also to certify to the S.A. or J.P.s whenever the certificate of a M.O.H. or medical practitioner is required.

(5) To advise the S.A. on all sanitary questions involved in the making or working of bye-laws, &c.

(6) On receiving information of the outbreak of any dangerous infectious disease, to visit the place without delay, inquire into the causes and circumstances, advise as to preventive measures, and take any such authorized by statute or local regulation.

(7) Subject to the instructions of the S.A., and in such manner as they may approve, to direct and superintend the work of the S.I.s.; and when appealed to by the S.I. as to any nuisance, to take as early as practicable any steps that he legally may, and which appear to him necessary or justified under the circumstances.

(8) Whenever it appear to him necessary or advisable, or he be instructed by the S.A. to do so, to inspect and examine any animal or article of food exposed or intended for sale, or for preparation for sale as food for man. If such animal or article of food appear to him diseased, unwholesome, or in any way unfit for food of man, he shall himself, or by an assistant, seize it and carry it away, to be dealt with by a J.P. under P.H.(L.)A. § 47, P.H.A. § 117. See also P.H.A. §§ 116—119, and P.H.(A.)A. § 28.

(9) To perform all duties legally imposed on him by any bye-law of the S.A.

(10) To inquire into any offensive trades, and report as to any practicable preventive measures.

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[1] For list and explanation of abbreviations used throughout this section see *post*, pp. 222, 223.

(11) To inspect from time to time all bake-houses and workshops, and report thereon to S.A. in respect to the provisions of the F. & W.A. 1878, §§ 34, 35, and 81, and of F. & W.A. 1883, §§ 15 and 16.

(12) To attend the office of the S.A. as required.

(13) To report from time to time in writing to the S.A. his proceedings, and any measures he may deem advisable in the interests of the public health ; as well as on the occurrence of sickness, and the mortality therefrom.

(14) To keep a book or books provided by the S.A., and enter therein his visits, observations, and instructions ; all applications made to him, and his action thereon, &c., and to produce the same to the S.A. whenever required.

(15) To make an annual report to the S.A. up to December 31 of each year, giving—(1) A summary of the action taken, or which he has advised the S.A. to take, for preventing the spread of disease ; (2) An account of the sanitary state of the district ; (3) All inspections and inquiries he has made ; (4) Proceedings which he has taken or advised in connection therewith under any statute ; (5) All sanitary supervision exercised or advised by him over houses and places, with the nature and results of any proceedings connected therewith ; (6) Action taken by him or on his advice in regard to offensive trades, factories, workshops, &c., and dairies ; and (7) Tables (on forms supplied by L.G.B. or to the like effect) of sickness and mortality, classified according to diseases, ages, and localities, during the year.

(16) To give immediate information to the L.G.B. of any outbreak of dangerous epidemic disease. To transmit to L.G.B. copies of all annual and special reports, and forthwith to inform L.G.B. of his having advised the S.A. to close any school, and the grounds of his advice.

(17) To forward to the County Council at the same time duplicates of all reports, &c., under (16).

(18) In all other matters to observe and execute all instructions issued by L.G.B., and lawful orders, &c. of S.A.

(19) To observe and execute all regulations declared by L.G.B. to be in force in his district under § 134 P.H.A., and § 113 P.H.(L.)A., so far as they relate to his office.

Relation of Medical Officer to the S.A. and its other Officers.

While bearing in mind that he is the officer, technically the servant, of the Sanitary Authority, that it is his duty to report and advise only—all action and responsibility, except as otherwise enacted, devolving on the authority—the Medical Officer of Health should seek, by tact and courtesy, by judgment in action and clearness in counsel, to command the confidence and respect of the S.A. so as to obtain a considerable degree of freedom of action in all cases in which the delay inseparable from the practice of waiting for the sanction of the Board or Committee at its next meeting would be dangerous or inconvenient. The more willingly this liberty is conceded, the more averse should he be to use it when the plea of emergency cannot be raised; and when the proceedings in question may be represented as harsh, vexatious, or vindictive, or are directed against persons in any way connected with the Board, he should insist on the Sanitary Authority assuming the responsibility whether of action, or of the consequences of neglect. He cannot demand, but he must claim and will rarely fail in obtaining, the subordination of the sanitary inspectors, who should act under *his* orders, report *to him*, and *through him* to the Board. Even when there is a superintendent inspector he should be deemed the lieutenant of the medical officer, the next in command, not an independent or co-ordinate officer, as the engineer or surveyor.

With the surveyor or engineer he should cultivate friendly relations, for he cannot claim more. The law authorizes him to advise on the *sanitary aspects* of all acts of the authority, and he may avail himself of this in many ways, provided he and the surveyor or engineer enjoy one another's confidence, and are in the habit of exchanging ideas on the common and border-lands of their fields of work. But though sewerage works and many other undertakings which properly devolve on the engineer or surveyor have a direct bearing on the public health, it is not as a *Health Officer* that he designs and controls their construction: and he has in like manner enough to occupy the time of his staff in superintending the making of roads, and in enforcing the Building Bye-laws in respect of the alignment, construction, stability, and safety of buildings of every kind.

The Medical Officer of Health should claim for himself and his inspectors the supervision of the *sanitary arrangements and house drains* in all new buildings, and in those that may from time to time be more or less reconstructed. This division of labour will always be found to work well, since the drains, &c. have little or no connection with the architecture of a building, and sanitary science and art does not receive much consideration from the generality of architects and surveyors. Besides, since the detection and remedy of any defects in these arrangements devolves on the sanitary inspector, it is at once fair and expedient that he should control the original execution of such work.

So too in his relations with the analyst: they are colleagues and co-ordinate officials under a common authority. The inspection and condemnation of unsound food belongs to the medical officer, the examination of adulterated articles of food, drink, and drugs, under the Sale of Food, &c. Act, and of water supplies, and perhaps gas, to the analyst. But the analyst must not forget that he is only a chemist: his duty begins and ends with the determination of the composition of the sample submitted to him; he is not a physiologist or physician, and should abstain from expressing opinions on the medical aspects of his results; if he do he is exceeding his powers, and such indiscretion on his part may lead to a conflict of evidence in court, injurious alike to the reputation of the officers and to the cause in which they are each engaged. The chemist states facts, the medical officer interprets them and explains their bearings on the public health.

Duties of Sanitary Inspector.

In U.S.D. he should have an office where he may be seen at stated hours, and to which letters may be addressed. He should attend there daily not later than 10 a.m., to read letters and arrange his work for the day, returning at 4 or 5 p.m. to enter reports of all he has seen and done, and to post up day by day his journal and such other books as it is expedient to keep. In R.S.D. he will do all this at his house, but should attend at least once a week at the office of his Board, which will usually be at the Workhouse, for consultation.

Duties imposed on Inspectors by L.G.B., &c.

(1) He shall perform all the duties imposed on him by the P.H.A., &c., and O.C.s, under the directions of the S.A., or so far as the S.A. may authorize, of the M.O.H., or in the absence of special instructions, of his own accord. It is unfortunate that the relations of the M.O.H. and S.I. are not expressly defined by L.G.B., but they should endeavour to obtain a clear understanding from their S.A. The M.O.H. and S.I. should co-operate in perfect harmony, the S.I. acting as assistant to the M.O.H., keeping each other informed of all that they are doing or intend to do, and scrupulously avoiding any appearance of conflict of opinion or action. He should consider the M.O.H. his superior officer, and since a section of the order of L.G.B. directs him to produce his books to the M.O.H. when required, and to afford him all the information he can on matters in his province, such is evidently the intention of the L.G.B. The S.I. is mentioned by name in P.H.A. § 36, as reporting to S.A. on houses without sufficient w.c. or other s.c. P.H.A. § 41; P.H.(L.)A. § 41, giving him power of entry after 24 hours' notice for examination of drains, w.c. or s.c.'s injurious to health. P.H.A. § 49; P.H.(L.)A. § 35, as reporting to S.A. on accumulations of dung, filth, &c., that ought to be removed. P.H.A. § 116; P.H.(L.)A. § 47, empowering him to inspect any food, and

seize all that may be unsound for production before a J.P. P.H.A. § 118 ; P.H.(L.)A. § 47, imposing penalty on persons obstructing him. P.H.A. § 119, empowering him, on warrant of J.P., to enter premises where he suspects unsound food to be kept. He is also intended in all those clauses where "an officer" of the L.A. is authorized to take action for the suppression of nuisances. In the P.H.(W.)A. § 3, as reporting to R.S.A. on the absence of available supply of wholesome water in any occupied house. In F. & W.A. 1878, § 4, as accompanying Inspector of F. and W. for inquiry into nuisances in any F. or W. In I.D.(P.)A. § 17, as having power of entry between 10 a.m. and 6 p.m. for the purpose of disinfecting houses, &c.

(2) "He shall attend all meetings of the S.A. *when required.*" It would be far better, and prevent much misunderstanding and delay, if he were to be present at *all meetings ;* but to avoid loss of his own time, he should induce the S.A. to take up all matters in which he is concerned at a fixed hour.

(3) "He shall by inspection of the district both *systematically at certain periods and at intervals,* as occasion may require, keep himself informed in respect of nuisances requiring abatement," &c. This systematic inspection is the most important part of his duties, and should be carried on without interruption by other business. So only can he *discover* nuisances or acts of default of which complaint might, or from their nature would, never be made. Some parts of a district inhabited by the wealthy classes will need such inspection only at long intervals, while the poorer and crowded quarters, and those where offensive trades are carried on, will demand constant vigilance. The frequency and order in which each district is to be visited should be determined on by the M.O.H. and S.I. in consultation, and adhered to, except by mutual consent, and for sufficient reason.

Inquiries into Nuisances.—Besides keeping a constant watch for every kind of nuisance or violation of the law, he should attend to every complaint brought to his notice, whether openly or anonymously, but never take such information for granted, since it may be made through misapprehension or in malice ; nor should he neglect anonymous allegations, for it often happens among the poor that the complainant is at the mercy of his landlord or employer. By tact and a kindly attitude, gentle remonstrance and reasonable representation of his mission as the guardian of the best interests of the public, the S.I. will in most cases be able to effect his purpose by persuasion, without having recourse to legal procedure ; but on the other hand, when the offence is inexcusable, and the deliberate act of unscrupulous greed, he should show himself no respecter of persons, nor hesitate for a moment to invoke the power of the law.

Books and Records.

'He shall keep a journal in which he shall enter day by day an account of all inspections made and action taken by him in the execution of his duties. Also a continuous record of the sanitary conditions of all premises in respect of which any action has been taken. Also any others that the S.A. may require or approve." These are to be provided by the S.A. : no form is prescribed by L.G.B., but good ones are supplied by Messrs. Shaw & Sons, and by Messrs. Knight & Co. The books required will vary somewhat in different places, according as the S.D. is united or rural, and single or combined, or if single, divided into wards, &c., and also to some extent with the nature of the duties imposed on the Inspector.

In all districts he must keep (1) a *pocket note-book*, arranged in spaces for entering on the spot (*a*) a full description of the premises, the name of the occupier, and the name and address of the owner as well as of his agent, if any; (*b*) the number, sexes, and ages, *i. e.* whether adults or children, of the inmates; whether of one family or more, and their mutual relationship. (*c*) When there is reason to suspect over-crowding, he must learn the extent and appropriation of the sleeping accommodation, noting the dimensions of the sleeping-rooms, and the number of persons occupying each. This is a delicate duty, requiring tact, and not to be needlessly undertaken, though much may be inferred from mere observation. (*d*) In town houses the position of the water-closet, the pattern, and its condition as regards repair and cleanliness, the source, mode, and sufficiency of the water supply, condition of repair of the apparatus, and whether in direct connection with cistern for drinking water. In rural cottages, the privy where situated, size of cesspit, pervious or not, its distance from the well, and in this connection the nature of soil and subsoil, and dip of the strata as regards the well and the cesspit. (*e*) The water supply in towns, constant or intermittent; size, position, materials, covering and condition of repair and cleanliness of the cistern. In rural places, the well, its position, depth, covering and relation to cesspit, pig-sties, or other sources of pollution. If this be not unimpeachable, and always in the case of *public* wells, a sample of the water should be taken for analysis, in stone jars, or better in Winchester quart bottles, supplied from the laboratory and sealed by the Inspector on the spot. (*f*) The arrangement of the drains, whether brick or pipe, under the house or not; whether rain-water pipes, sink wastes, &c., are connected or disconnected, and the position, pattern and repair of all traps and gulleys. (*g*) The paving, if any, and general condition of the surface of the yard and ground around the dwelling. (*h*)

The description, position, size and state of repair, wetness, &c. of ash-pits, dust-bins, or refuse heaps, whether offensive or not, and the nature of the refuse, whether ashes only or kitchen stuff or manure. (*i*) Whether and what animals, pigs or fowls, and how many, are kept, where and whether cleanly or the reverse, free or confined. (*j*) The general state of the house as regards the repair of walls, roof, ceilings and floors, dampness, ventilation; size of windows, whether and how far opening; the absence of chimneys in bedrooms; material, repair and ventilation of basement or ground floors; and in towns the conditions of underground rooms, in respect of the requirements of the P.H.A. and P.H.(L.)A. respectively. (*k*) If any trade is carried on, what and under what conditions, and if refuse, &c. be stored in backyards. (*l*) The recent occurrence of infectious disease among the inmates, or of the frequent presence of diarrhœa, sore throats, &c.; and lastly (*m*), any other facts on which the M.O.H. may desire information.

So far as the sanitary defects observed are due to the action or neglect of the occupants of the house, and remediable by them, the Inspector should seek by persuasion to obtain their abatement without legal proceedings. If there be any "nuisance," or the premises be in an insanitary condition, he should make a short but comprehensive report, with suggestions for the abatement of the nuisance or improvement of the premises, to be presented by him to the S.A. at their next meeting, in which he should where practicable name the parties responsible for the nuisances or sanitary defects.

(2) A *journal*, posted daily for methodical entry of the principal facts noted in the pocket-book, with the Inspector's recommendations, and any action taken by him, by the S.A., or by him subsequently. This book should be produced by the S.I. whenever he attends the meetings of the S.A., and signed or initialled by the chairman.

(3) Where the I.D.(N.)A. is in force a book should be kept in which should be entered in parallel columns particulars of all cases of *D.I.D.*, notified to the M.O.H., or observed by S.I. in his inspections, viz. date, residence, age, sex, disease, condition of premises, probable cause, action taken and date of disinfection of premises.

(4) A *complaint book* for registering dates and particulars of all complaints made, and by whom (noting if any reason for suspecting malicious motive), names, &c. of persons responsible, date of Inspector's visit, result of his inquiry, and reference to page of journal where action or proceedings taken are recorded.

(5) *Sanitary survey books.*—One for each parish, ward, or other division of the district, giving for each street and house the facts ascertained in the course of his systematic inspection,

as in the note-book, with space for noting any changes or improvements made from time to time. The value of such a book of reference is obvious, and on the receipt of any complaint, it will often obviate the necessity for a lengthy investigation, or at any rate will indicate the direction of the inquiry.

(6) He must be supplied with copies of all Acts of Parliament, orders in Council, memoranda of L.G.B., bye-laws of the S.A., and the forms required for notices, &c., and with advantage printed forms for reporting nuisances or cases of *D.I.D.* to M.O.H. It is not incumbent on him, but it would be very desirable, that he should make out an annual report of his work, &c., addressed to the M.O.H., for publication as an appendix to his report.

Qualifications and Diplomas.

Since 1895 in London, though not as yet in the provinces, S.I.s have been required to hold a diploma recognized for the time being by the L.G.B., those of the Sanitary Institute, for example. The S.I. should certainly not fail to acquire a practical acquaintance with surveying and building construction, so as to be able to judge of the character of works in progress, the defects or omissions in a specification, &c., and to draw up a serviceable specification of minor works required for abatement of nuisances not of such magnitude as to demand the assistance of the surveyor. Indeed in R.S.D. the S.I. is not unfrequently appointed also surveyor to the district.

Mode of conducting Inspections.

The ordinary inspections of streets and houses should not be made perfunctorily and superficially, but be carried out on a strictly uniform plan, which, at first carefully prepared in accordance with local circumstances, shall become a habit and a guarantee that nothing has been overlooked. The discovery of omissions, necessitating repeated visits, and ending perhaps in the detection of defects that had not been suspected, is annoying to the Inspector, harassing to the occupiers, and weakens the confidence of the Sanitary Authority in the perception and judgment of their officer, who should aim at achieving a deserved reputation for unerring powers of observation, and a clear apprehension of the requirements in every case. The general course of inspection should be as follows—

(1) Note the conditions of the street, roadway, footpath, and approaches as regards materials, inequality of surface, slant, state of repair, and the presence or evidence of standing-water or accumulations of filth or rubbish ; also what, if any, provision exists for surface drainage.

(2) Looking at the houses from without, note whether there are areas or not. If there be an area is it open or covered in, or what is called a box area, and is it drained and how? If there be no areas, are the floors above or below the level of the adjacent ground, and how far? Note the materials, and state of repair, of the exterior walls and roof, so far as can be seen, especially as regards damp; the pointing and plastering, rain-water pipes and butts if any, and the gutters. If the walls appear damp is it to be accounted for by defective gutters or pipes, or does the damp rise from the ground? If the floor be above the ground level, is the space beneath ventilated or not, and if so, is there sufficient provision for through currents of air? Are the rain-water and waste-pipes connected with or disconnected from the drain, and are the surface drains provided with gulleys, bell-traps or none?

(3) Passing through into the back-yard repeat the observations as to paving, drainage, &c., and as to the exterior of the building. Note size of yard, height of walls and surrounding buildings. Are there accumulations of filth, rubbish, or lumber? any hutches or fowl-houses? any other animals kept? and any collection of manure? or evidence of rats? What is the form, size, repair, and general state of the dust-bin or ash-pit, and the nature and state of its contents? Observe carefully the cistern, its position, size, material, cover, and the condition of the water. Is the supply constant or intermittent, and if there be a draw-off tap, does it leak, and is there a gully beneath it?

(4) The w. c. must be closely examined, its position in the house, area or yard, its ventilation and lighting. Is the water-supply direct from the general cistern, or through a small service cistern, or from the main? If there be a water waste-preventer, what is the pattern, and is it in working order? Is the flush reasonably adequate for its purpose? What is the form of the hopper, broad or narrow? is it sound or broken, fairly clean or foul, and is the connection with the siphon sound or leaky? How many families or persons use or have access to the closet? and is there a proper door and fastening?

(5) Returning into the house, note the conditions as regards dirt, damp, and repair of the floors, wall surfaces and ceilings, as well as of the stairs. Enquire for rats and rat-holes within and without the dwelling. If any underground rooms, are they occupied legally or otherwise? note the size of the sleeping-rooms and the number of occupants so far as can be learnt (*rarely by direct questions, but rather incidentally and in some wholly different connection*). Note the ventilation, the size of the windows, and to what extent they can be opened; also if there are rooms without chimneys? The sink is one of the most important of "sanitary conveniences," and no doubt must be left as to its

relation with the drain, for with direct communication all other sanitary precautions are useless. The possible arrangements are (*a*) a waste descending perpendicularly to the drain with no trap except the useless bell, (*b*) connected, but with a syphon bend interposed, (*c*) disconnected over a gully beneath the sink, the floor and wall of the scullery being always wet with the splashing, and (*d*) disconnected over a gulley outside the house, the only permissible arrangement.

In rural districts the privy must be inspected and notes be taken of its general condition, and distance from any well. The dimensions and construction of the cess-pit, whether pervious or impervious, and receiving slop-waters or not. The well, its depth, steyning, whether cemented or not, whether the water be ground-water or from deeper beds ; the direction of its course, whether towards or from any possible sources of pollution, as cess-pits, dung-hills, straw-yards, &c., and the distance in any direction of such from the well. Whether the well is open or covered, above or below the ground level, and worked with pump or bucket; also what is the character of the ground around, earth, grass or paved. When the water is obtained direct from a river its circumstances should be carefully inquired into.

Houses unfit for Human Habitation.

There is, as a rule, little difficulty in deciding whether any given condition or arrangement is "a nuisance, or dangerous or injurious to health," and capable of being made the subject of a "nuisance order" or "order for abatement." But it is not so easy to determine what defects intrinsic or extrinsic render a house "unfit for human habitation," and whether such defects are remediable or not, *i. e.* whether a "closing order" will suffice or nothing short of "demolition" can meet the case. The power so freely given by the London and, to a lesser extent, by the P. H. Acts of specifying the alterations and works absolutely necessary to render it habitable, happily leads in many cases to a solution of the question of demolition by the owner himself, who finds the extreme resource less costly than repair. It is therefore better, unless the conditions be clearly irremediable, to obtain the order for closing only until the house be rendered habitable, provided a strict watch be kept over the work, to ensure its being as thorough as the circumstances permit, and such as to avert an early recurrence of the evils.

Orders for demolition, *i. e.* confiscation with or without adequate compensation to the owner, and involving eviction of the occupiers, are not to be made without a due sense of the responsibility incurred ; but the conditions rendering a house unfit for habitation, at any rate until they are removed, may be defined as (1) Liability to flooding of the basement or ground floors, especially foul water or sewage. (2) Obstruction of the drains. (3) Drains ventilating directly within the dwelling. (4) W.c.'s without water-supply, broken or leaky. (5) Floors damp, unventilated, rotten and broken. (6) Drains under dwelling defective, as evinced by rat-holes. (7) Walls rotten and saturated with moisture, whether from without or by upward absorption from below. (8) Foul closets within the house in improper positions. (9) Dust-bins similarly situated. (10) Low rooms without chimneys, with windows incapable of opening or without windows opening to the air, at least if used as sleeping-rooms. (11) Roofs so defective as to let in the rain. (12) Underground dwellings occupied in contravention of the P.H.A. (13) Back to back houses without adequate compensatory access of air and light in front. (14) Groups of houses with insufficient or improper privy accommodation. (15) Houses without water-supply or easy access to a common public supply, and some other defects of a character equally incompatible with health, cleanliness, or decency. (See Appendix D.)

Unhealthy areas may be defined (1) as areas in which the majority or a large proportion of the houses present some or other of these defects to such an extent as to render their complete removal absolutely or practically impossible. (2) Areas largely constituted of blind or communicating courts and alleys, which, though they might be tolerated if single, are in the aggregate such as to preclude any reasonable ventilation, and where the opening up of throughfares in different directions is impracticable, or would be only a partial removal of the evils. And (3) areas in which the mass of the houses are dilapidated beyond repair.

INFECTION AND DISINFECTION.

Infectious Diseases.

In all inquiries as to the origin and propagation of infectious diseases in particular outbreaks, and in devising measures for their suppression, it is necessary that one should have a clear idea of the means by which each disease is communicated, the duration of the *incubation* period, or that elapsing between the reception of the contagion and the first appearance of febrile symptoms, and of that between this sickening or *invasion* and the *eruption*, if any, as well as of the length of time during which the convalescent retains the power of communicating the disease to others; and lastly of the best means of disinfecting persons, places, and things.

Periods of Incubation and Infectivity.

These periods, during which there are no signs of illness, differ greatly in different diseases, but vary little in each. Though not absolutely constant, the wide ranges, as from 1 to 21 days, given in books are based on errors of observation, or on fallacies of inference. People may contract a disease on the first exposure, or resisting it for a long time succumb at last; they may take it, not from the patient, but from infected things left behind, and so on.

The *D.I.D.* named in the I.D.(N.)A. are, Small-pox, Typhus, Enteric (Typhoid), Relapsing Fever (Continued fever—a name given to obscure cases of Typhus or Enteric), Scarlatina, Diphtheria (Membranous croup, which is another name for diphtheria affecting the larynx), Erysipelas, and Puerperal fever (a general name for blood-poisoning in the puerperal state).

Small-Pox.—The eruption appears on the 13th or 14th day from infection, the incubation lasting 10—12 and the invasion 1—3 days. In unvaccinated or imperfectly vaccinated persons the disease lasts from two to three weeks, in the vaccinated rarely longer than one week. It is communicable until the scabs have fallen and the scars have healed.

Typhus.—Incubation about a week. Eruption follows an invasion of one day, the onset of the fever being very marked and sudden.

Enteric.—Incubation about 14 days, but the invasion being gradual and insidious, the illness may not be recognized until three weeks from infection. The duration of the disease is properly a month, but may be shorter, especially in children, among whom it often does not exceed a fortnight. There is danger of infection until the stools have become perfectly healthy. Relapses may occur, prolonging the illness to twice or thrice its normal duration.

Relapsing Fever.—Incubation short but uncertain. The disease is, however, rarely met with now.

Scarlatina.—Incubation mostly two days, may be shorter after intense exposure, or in some cases longer, but rarely if ever over four days. The invasion occupies one or two days, the fever itself eight to twelve, and the patient is a source of danger so long as any peeling goes on, or the throat, nose, and ears are not perfectly healthy, at least six to eight weeks.

Diphtheria.—Incubation short, usually two days, but varies with intensity of infection and power of resistance. Apparent extension beyond four days is really due to the nature of the disease not being recognized. Infection lasts a long time, that is until the throat has resumed a perfectly healthy state.

Erysipelas and *Septicæmia* (of which puerperal fever is one form) have not an incubation properly so called. The febrile symptoms begin in a day or so after infection, and the nature of the disease is manifested in one or two more. Infection lasts until the disappearance of all the symptoms.

Other Infectious Diseases.

Measles.—Incubation 10 days, eruption appearing on 14th, after three or four days of an invasion marked by catarrh. Infective for ten days or a little more from date of eruption.

Whooping-cough.—Incubation about ten days, the cough not becoming characteristic until about four to six days later. Infectious until after the cough has ceased, unless it be unnaturally prolonged by exposure beyond its normal duration of three or four weeks.

No other infectious diseases are likely to be made notifiable.

Quarantine and Isolation.

Quarantine, or the time during which persons who have been exposed to infection should be kept from associating with others susceptible to the disease, should exceed by several days the longest probable period of incubation of the given disease ; and should one of a party of suspects give evidence of having been infected, the quarantine of those who have been associated with him during the days immediately preceding must be resumed. Suspects must not retain in quarantine the clothing in which they were exposed, since it may be infected, though they have not up to that time been so.

Isolation.—As quarantine must be determined by the incubation period, so must isolation by the persistence of infectiveness after convalescence. In enteric fever no such isolation is required after complete recovery. In measles, rubeola, and chicken-pox, three weeks. In diphtheria, mumps, and whooping-cough, four weeks. In scarlatina and small-pox, six weeks, provided in all cases all eruptions, peeling, &c. have entirely disappeared, and all clothing has been changed or disinfected, and in scarlatina and small-pox the hair has been cut short and disinfected. In small-pox, scarlatina, and diphtheria, all clothes that cannot be boiled should be burnt. In cholera, enteric fever, small-pox (and diphtheria if well marked), mattresses and pillows should be burnt ; in scarlatina the stuffing may be baked.

Ways and Means of Infection.

In enteric fever and cholera the poison is contained in and conveyed by the evacuations, which should be disinfected before being discharged into drains or cess-pits, or in country-places buried. The usual modes of infection are by drinking water polluted by the excreta, or by eating after having attended to the sick without washing the hands. In close, crowded, and stuffy rooms the poison may be inhaled from bedding, &c. soiled by the evacuations.

In scarlatina, diphtheria, measles, whooping-cough, and influenza, the breath of the sick and the mucus from the eyes and nose are infectious. In scarlatina, the dusty scales cast off from the skin in peeling are also active means of infection. In scarlatina and diphtheria pocket-handkerchiefs must not be used, but soft rags, which must be immediately burnt.

In small-pox the infectiveness increases daily from the first onset of the disease to the complete shedding of all scabs. The most virulent vehicles of infection are the exhalations from the matured pustules, and the dust from the dried scabs.

In small-pox, scarlatina, and diphtheria the room should be promptly stripped of all carpets, hangings, &c. No stuffed furniture, quilts, rugs, &c. that cannot be boiled should be allowed. The furniture must be limited to bare tables, wooden chairs, washing-stand, and iron bedsteads. The best pillows and mattresses are those stuffed with zostera or sea-wrack (commonly but incorrectly called ulva), which being very cheap may be burnt, the ticks and covers being boiled. Such mattresses are specially advisable in enteric fever, in which a waterproof sheet should also be spread immediately over the mattress, to prevent its being saturated with the liquid stools.

PREVENTIVE MEASURES.

Disinfection.

An immense amount of tradition and superstition still lingers about the matter of disinfection, not only in the vulgar mind, but even among those who ought to be experts. Aerial disinfection is an utter delusion. It is hard to imagine a germicide that will kill the microbes of disease without hurting the patient, but certainly non-volatile agents, as permanganates, are obviously useless, and carbolic acid and "chloride of lime" are no less so. Aerial disinfection, even after the removal of the patient, is a misnomer. We do not want to purify the old air, which should be wholly removed by free ventilation. It is the house that has to be disinfected by the destruction of all microbes, and their spores, that have adhered to the surfaces of walls and floors, been deposited on projections, or have insinuated themselves into holes and crevices.

The careful experiments of Uffelmann, combining the most scientific precision with the actual conditions of sanitary practice, show that the time-honoured sulphurous acid, together with its rivals, chlorine, iodine, bromine, and nitrous fumes, are all alike inert, except in the presence of water. Perfectly dry spores will stand with impunity every reagent except heat, and in the presence of moisture those above mentioned bleach or discolour all fabrics and tissues.

All bedding, hangings, and coverings that cannot be washed should be soaked in a solution of corrosive sublimate, 1 part in a 1000, *i.e.* 80 grains to the gallon, or "formaline," 1 part in 20 of water, or exposed to heat, by preference steam under pressure, in a proper disinfecting oven.

Metals may be disinfected by heat, or simply by polishing, as may most articles of furniture, while the walls should be sprayed, or washed, and the floors scrubbed with the 1 per 1000 sublimate solution.

It has no injurious action on paint, plaster, varnished or plain wood, or washable papers; others will of course be stripped. There is really no appreciable danger attending its use. The sublimate is by far the most efficient germicide known, and is cheap and easy of employment. For ceilings and plaster walls an application of *lime* (not white) *wash* is scarcely less effective; if the lime be freshly burnt all germs are killed in the course of twenty-four hours. Frequent lime-washing of walls and ceilings is therefore a most useful routine.

If, however, the authorities insist on sulphur fumigation the process must be conducted as follows:—The paper having been stripped off the walls, and the entire surface of walls, ceiling, and floor saturated with water, the chimney closed, and the chinks of the windows sealed with strips of paper and paste, the sulphurous acid is evolved by lighting a quantity of crushed sulphur moistened with spirit or benzol in a metal dish, or, as this is apt to go out, by burning one or more large lamps filled with bisulphide of carbon instead of oil; but best of all is the liquified SO^2, supplied, like other compressed gases, in wrought-iron cylinders, from which the gas escapes on turning a cock, a method which avoids all risk of fire. The door is sealed with paper and paste and left closed for twenty-four hours.

Formic aldehyd is a powerful and penetrating disinfectant in high esteem of late. It is sold under the name of "formaline" in a 40 per cent. alcoholic solution to be diluted for use as a wash or spray, and in solid tabloids of the isomer paraformaldehyd, which, heated in a special form of lamp, called the "Alformant," give it off as pungent and irritating vapour or fumes, believed to be more effective than those of sulphurous acid.

When the walls are covered with paint or other impervious material, as lincrusta, there is of course no need to remove it as when they are papered. When the work is done ceilings must be lime-washed, and so must walls if not painted.

In disinfecting excreta the proportion of the reagent must be calculated on the volume to be treated, thus a gallon needs a pint of a 1 per cent. solution to get 1 part in 1000.

Disinfecting Ovens.

Bedding, carpets, and other things that cannot be boiled are disinfected by heat in a proper oven. Lyons', Reck's, Thresh's, and the Equifex are the best patterns. These articles are subjected to the action of steam under high pressure, *dry steam* in fact, which displaces the air in the mattresses, and penetrating the entire substance, rapidly raises every part to a temperature above 220° F. without injuring the most perishable materials, as hair, feathers, or down, whereas the time required to heat such articles throughout in other ovens would completely spoil them.

All washable articles, sheets, blankets, and linen, should be plunged into boiling water, not boiled up gradually, and kept in it for at least ten minutes. But when bedding, &c., of little value, are soiled by excreta or other discharges, they are best burnt, and in the case of poor owners replaced at the cost of the Sanitary Authorities.

Many substances have been recommended for disinfecting w.c.'s, cesspools, drains, &c., crude carbolic acid, zinc chloride, sulphate of iron, being among the best; sublimate again surpasses any of these, but it cannot be used where it would come in contact with metallic surfaces. This is its only defect. It would be advisable that solutions naturally odourless and colourless, as sublimate and zinc chloride (Burnet's fluid), should be coloured with indigo, or laundry blue, to avoid accidents.

INFECTIOUS HOSPITALS.

The accommodation should under no circumstances be less than one bed for every thousand of the population, and more in seaports and towns having large poor populations and much aggregation of work-people in mills and factories.

The site should, if possible, be removed from other habitations, but not too distant from the districts whence the patients are drawn. Sheltered from east and north-east winds by rising ground or trees so far as practicable, or by the arrangements of the buildings themselves, but open to the freest possible circulation of air, and standing in its own grounds of several acres, pleasantly laid out and planted, with sheltered seats, &c. for convalescents.

Different fevers should be treated in completely isolated wards or blocks, and the "administration" or offices and tradesmen's approaches removed from the wards and exercising grounds for convalescents.

If consisting of more than two or three wards, it should be broken up into distinct blocks. There should not be more than two floors in any block. No ward should have more than six or eight beds, nor each patient less than 3000 cubic feet, 150 square feet of floor, and 12 feet of wall space. The height of the ward should be 13 or 14 feet, and the window space at least one square foot to every 60 cubic feet in the wards.

Free ventilation without draughts, and open fireplaces as well as hot-water pipes, but the latter should be used to warm the incoming air and not, as is almost always the case, to heat without renewing the air.

The wall surfaces of the wards should be smooth, washable, impervious, and without angles, cornices, or any projections over doors, &c., to retain dust (and germs). The floors of parquetrie or tongued boards, rendered impervious with wax or paraffin wax. Walls and ceilings painted blue.

A covered verandah on the sunny side of the ward, into which the windows shall open down to the floor, so that in summer the beds may be wheeled out whenever the weather permits, would conduce to the comfort and recovery of the patients. Ample supplies of hot and cold water, baths, &c.

The nurses' bedrooms should be spacious and comfortable, and so placed that the nurses when on night duty may have their day sleep undisturbed.

The laundry should be at a distance, not only from the buildings, but also from the boundary wall and approaches, and have a steam chamber for disinfection, and furnace for destroying foul articles attached.

A mortuary and post-mortem room, stables, &c., will be required in every case.

In rural districts, in the event of an epidemic of enteric fever, diphtheria, or scarlatina, it might suffice to engage an isolated cottage, the surroundings of which were satisfactory from a sanitary point of view ; or Docker's portable felt huts, or even tents might be hired for the occasion.

FACTORIES AND WORKSHOPS.

The functions of the Health Officer in respect of factories and workshops are indicated in §§ 3 and 4, F. & W.A. 1878, &c., and relate to the (1) general cleanliness, (2) freedom from effluvia from w.c.'s, privies, drains, &c., (3) overcrowding and (4) ventilation, which is to be such as, "so far as practicable, to render harmless all gases, vapours, dust, &c., generated in the processes carried on." Proper sanitary conveniences and separate accommodation for the sexes are required by P.H.(L.)A. § 38, and by P.H.A. § 38, or P.H.(A.)A. § 22. The not unfrequent location of the w.c. within the workshop is clearly a contravention of the Act.

The M.O.H. has the same rights of entry as in the case of other houses where he has reason to suspect the existence of a nuisance. The factory inspector is bound to report to the S.A. any sanitary defects he may notice, and he may take the M.O.H. with him in his visits, while the latter is in turn to report to the F.I. the employment of children, women, or young persons contrary to the law. It is therefore most desirable that they should cultivate friendly and confidential relations.

"Ventilation" as defined in the clause referred to is a comprehensive expression. It is clear that the M.O.H. is entitled to condemn any practice or arrangements which he may deem "injurious or dangerous to health," he may insist on better ventilation in the usual sense, and prescribe the system to be adopted, but as to ventilation as a means of removing gases, vapours, or dust, if it involve modifications of the process or special appliances, he may only make suggestions for the consideration of the F.I., or merely call his attention to the evil, leaving the remedy to him. With the largest factories—cotton, linen, woollen, and silk mills for example—the M.O.H. will have little to do ; the evils of machinery accidents, high temperature, steam, and dust are being steadily and indeed rapidly removed or greatly ameliorated, as are those arising from metallic dust in steel grinding, and those of excessive heat and contact with poisonous solutions and pigments in ceramic industries, potteries, &c. Match-making and the silvering of mirrors are ceasing to be unhealthy employments save where known precautions are neglected ; but white-lead works present a problem which can only be solved by the substitution of some totally different process, as that of Prof. Gardner, all conceivable precautions having been proved powerless to render the "stack process" less deadly.

It is, however, in the smaller industries carried on in factories in crowded neighbourhoods, mostly old dwelling-houses adapted for the purpose, or in the homes of the operatives, that the greatest abuses still prevail. To this class belong those dependent on wholesale clothiers and other contractors who give out the work to middlemen or "sweaters" ; and most of all in the so-called "season trades," in which overcrowding and overtime are carried on under pressure for variable periods in unregistered places difficult of detection.

The officially recognized though not statutory allowance of 250 cubic feet per head, or 400 cubic feet where overtime prevails, should be permitted only on condition that ample ventilation is provided and enforced. Thousands of females are employed in this way at strawboard cutting, frilling, goffering and pleating, tailoring, costume, mantle, and corset making, the manufacture of cigars, envelopes, card boxes, valentine mounting, bookbinding, enamelling cards, &c. Laundries demand supervision also in respect of the conditions under which the women work, and in small private laundries as regards infectious diseases.

Artificial flower making, in which poisonous pigments are much used, is frequently most injurious to health.

Bakehouses.—The control of these has been transferred by the F.W.A. 1883, to the S.A., and for enforcing the requirements of §§ 15, 16, 17 and 18 of that Act, as well as of §§ 3, 33, 34 and 35 of the F.W.A. 1878, the M.O.H. is by § 17 sub. 1 of the F.W.A. 1883, invested with the powers of a F.I.; but the definition of a retail bakehouse in § 18 (2) of F.W.A. 1883, as "a bakehouse or place, the bread, biscuits, or confectionery baked in which are not sold wholesale, but by retail in some shop or place occupied together with such bakehouse," is unsatisfactory. A M.O.H. found himself unable to proceed against a place where *meat pies* were manufactured under disgusting circumstances, except by closing the house as unfit for human habitation and dangerous to health. Wholesale bakeries are factories, and sanitary defects therein must be reported by the F.I. to the S.A., who will then proceed under the Nuisance Removal clauses of the P.H.A. § 91 (6), or P.H.(L.)A. § 2 (*a*), not (*g*), which has reference to workshops not under the F. & W. Acts.

INSPECTION OF SHIPPING.

An order of the L.G.B., July 19, 1883, enjoins on S.I. under P.S.A. the regular inspection of the shipping in respect of nuisances to be abated under P.H.A. He shall also, as early as possible after receiving notice of the existence of such, or of the breach of any bye-laws or regulations of the P.S.A., visit the ships or vessels to inquire thereinto.

He shall give immediate notice to the M.O.H. of the occurrence within the district of any *D.I.D.*, or of the arrival in the port of any vessel having such disease on board; and also when he thinks the intervention of the M.O.H. desirable in respect of any nuisance on board, or of overcrowding of any vessel. Port M.O.H. and S.I. will find it greatly conducive to their influence, to render themselves familiar with the technical expressions of seamen, and the routine of life afloat, as well as with the construction and arrangements of ships and steamships.

INSPECTION OF MARKETS AND FOOD.

In large towns, where there are one or more public markets, whether the property of the L.A. or of companies, a special Inspector should be appointed, on whom should also devolve the inspection of dairies, cowsheds, slaughter-houses, and all places for the sale of meat, poultry, fish, milk, &c., and unless he have by long practice acquired a thorough knowledge of his duties, it would be well that he should have had a previous training as a veterinarian, or at least have a practical acquaintance with cattle, and be able to use a microscope.

Elsewhere one of the Sanitary Inspectors who may show an aptitude for the work should be especially set apart for the inspection of dairies, slaughter-houses, &c., either exclusively or in addition to his ordinary duties of Sanitary Inspector. But in any case he should be previously afforded opportunities of becoming familiar with the appearances presented by the flesh of animals of all kinds in health and disease, in the various stages of decomposition, and when in any way unsound or unwholesome; indeed the inspector of a regular meat market to which carcases are consigned from considerable distances should be more or less of a practical pathologist, and able to work with the microscope so far as is necessary for verifying the existence of tuberculosis, trichinæ, and other parasites.

Slaughter-Houses. L.G.B. requirements.

(1) To be at least 100 feet from any dwelling-house, and admitting external air on at least two sides.

(2) Lairs or pens sufficient to hold animals about to be killed, to be at a like distance from dwelling-houses, apart from the slaughter-house, and properly drained.

(3) No rooms to be built over slaughter-house, nor any direct communication between it and any stable or water-closet, privy, &c.

(4) The slaughter-house to be cross ventilated and well lighted, the floor of concrete or asphalt sloped to gutter leading to a trapped gulley outside with bars of grid not more than ⅜ inch apart. The walls to be coated with hard impervious cement or glazed tiles to 7 feet from the ground; above that height to be with the ceiling *lime*-washed at least once in every three months.

(5) There must be an ample water-supply with a galvanized tank at least six feet above and unconnected with the floor.

(6) Galvanized iron buckets only to be used, and all blood, offal, and garbage to be removed within 24 hours, not passed into the drains.

(7) Public slaughter-houses must be well lighted by gas or

electricity, since much killing is done at night. There must also be separate lairs and slaughter-house for suspected or condemned cattle.

Dairies, Cow-sheds, and Milk-shops.

The dairy, cow-sheds, &c. orders leave all details to the discretion of the L.A., though model bye-laws have been drafted by L.G.B. As regards dairy-farms, it is generally a dead letter. No provision is made for the appointment of Inspectors of Dairies and Dairy Farms, but it would be well to appoint an additional inspector under the P.H.A. for the special duty. Dairy-farms are often in a most unsatisfactory sanitary condition, and the S.A. ought to prescribe definite requirements.

When the stock consists of shorthorns, Ayrshire, or other hardy breeds, it is usual to leave them in the open field during great part of the year, and to house them in winter in open sheds. In such cases ventilation is ample; but when Jerseys and like delicate animals are kept in closed sheds they are very apt to suffer from defective ventilation. The warmth is derived from the heat of the animals, and though the yield of milk may be greater, the close atmosphere tends to develop tuberculosis.

Free through and roof-ventilation should be provided, and not less than 1000 cubic feet allowed to each cow, with a passage between the feeding troughs and the wall. The sheds, whether open or closed, should be paved; the customary stone "pitching" is unsatisfactory, since cleanliness and drainage are impossible. Brick paving is far better, or rough concrete or asphalt, giving a good fall, but not too smooth, or the animals may be unable to rise. The fall should be sufficient to conduct all urine and washings to a channel running the full length of the shed, and made of half-pipes glazed and bedded in concrete, or the channel may be a gutter moulded in the concrete with a good fall and a trap at its termination, whence it should lead to a tank, not to a pond or ditch. The manurial value of urine is great, and the neglect of this is wasteful as well as insanitary.

Straw-yards should be well-pitched and drained in like manner to a tank. The manure deteriorates greatly by exposure, through loss of ammonia and phosphates, &c., by evaporation and soakage into the soil. It should be removed at least once a week. Where straw is scarce, light earth may be used if the bottom is well paved and drained.

The cows should be kept clean, in fact "groomed," and the udders washed before milking, for the black sediment so often seen in milk is mostly dung. The litter in the sheds should be changed daily, and the floor washed down. Though *C.P.*, *P.P.* and *F.M.D.* only are referred to in the order, it is certain that all eruptive diseases of the udders should be deemed to render the milk unfit for human food. Tuberculosis at any rate if in an advanced stage, or involving the udders, should be a ground for condemning the milk.

The water-supply should receive more attention than it does. Troughs supplied by pipes should be provided, since they cannot be fouled by excrement. Cows will drink the foulest pond-water, though such water cannot but have an injurious influence on the milk.

Appearances of Cattle in Health and Disease.

Live cattle should be plump and active, the coat in good condition, the hide supple and clear. Eyes bright, mouth and nostrils moist but free from discharge. Respiration easy, almost noiseless. Breath without odour. No signs of pain or uneasiness.

Oxen weigh from 600 to 1200 lbs., cows 700—800 lbs., heifers 350—400 lbs. Sheep 60—90 lbs., pigs 100—180 lbs. Age, ox 3—8 years, perfection at 4 years, at 5 years all permanent teeth present, the last temporary being shed at 3 years. At 6 incisors are worn to level of grinders, which begin to show signs of wear. At 10 the worn surfaces show a square mark, after 12 a round one, each being surrounded by a white line. The rings on the horns correspond fairly to the years up to 5, after which up to the 8th they gradually disappear.

To Ascertain the Weight of Cattle.

Measure the girt close behind the shoulder, and the length from the fore part of the shoulder-blade along the back to the bone at the tail which is in a vertical line with the buttock, both in feet. Multiply the square of the girt, expressed in feet, by five times the length, and divide the product by 21 ; the quotient is the weight, nearly, of the four quarters, in imperial stones of 14 lbs. avoirdupois. For example, if the girt be 6 feet, and the length 5¼ feet, we shall have 6 × 6 = 36, and 5¼ × 5 = 26¼ ; then 36 × 26¼ = 945, and this, divided by 21, gives 45 stones exactly. It is to be observed, however, that in very fat cattle the four quarters will be about one-twentieth more, while in those in a very lean state they will be one-twentieth less than the weight obtained by the rule.

Hints for Inspection of Food.

Butcher's meat should be firm, elastic, moist, but not wet, and (except pork, veal, and lamb) *bright* red. If well fed, *marbled* from fat in muscles. Fresh pleasant smell from skewer thrust in and quickly withdrawn, juice faintly acid to blue litmus paper. Fat should show no blood-stains, jelly, or watery juice. Brine should not be sour.

Carcases well set as soon as cold. No difference in colour of opposite sides, nor purple, brown, or speckled discolouration. No bruises, or bile stains, muscles pressed with finger should not "pit" or crackle (from presence of water or air), nor be wasted. Offal should also be examined. Mouth and tongue free from blisters or blotches. Hide free from sores or pimples. Lungs bright *pink*, spongy and free from pus, &c., pieces cut off should float in water. Heart free from blotches, &c. Liver rich brown, not breaking easily under pressure, with no abscesses or flukes, &c. Spleen or milt, grey outside, dark inside, long, thin, with sharp edges. Stomach and intestines not inflamed, lining membrane not easily detached, no ulcers or blotches, or smell of drugs. The marrow should be of a uniform rosy red, firm in hind, diffluent in fore-legs.

Salt meat.—Salting will conceal slight putrescence, but if really *bad*, it will still be *soft*, perhaps greenish, and even have a sickly smell. So is good meat badly salted, it is also paler than it should be.

Partial decomposition.—Unpleasant smell, soft, tears easily, unequal resistance to knife, surface pale or livid, and later greenish. Litmus blue is not reddened.

Animals that have died or been killed when moribund. Flesh dark, often purple, full of blood, sets badly, soon decomposes. Juice neutral or alkaline, carcases often unskilfully dressed.

Meat Unfit for Food.

Cattle-plague.—Oxen only. Appearance in early stage normal, in advanced dark with disagreeable smell, sometimes crackling. But quite early mucous membrane of bronchi and intestines reddened, and the latter covered with a glairy blood-stained fluid. Later yellow cheesy masses in throat and nostrils, blood-stained patches in intestines and heart, commonly a cutaneous eruption. Symptoms in life, glairy discharge from eyes, nose, and mouth, dropping of ears, shivering, fever and purging.

Pleuro-pneumonia.—Oxen, but occasionally in sheep and swine. Flesh dark and ill-bled. Pleura roughened, lungs first grey with red or purple patches, and less spongy. Later dark and almost solid, pieces sink in water, weight increased from 7 or 8 lbs. to 30 lbs. or more. In pigs the intestines also are often inflamed and patchy, and the skin of belly may be reddened. During life, pain, fever, laboured breathing. Pleural cavity may be visibly distended with fluid.

Anthrax attacks cattle, sheep, and swine. There are three forms: (1) least frequent, marked by large boils; (2) black-quarter, one limb or more dark and swollen; (3) splenic fever. Flesh dark, and bile-stained and dropsical. Liver large and soft, lungs generally inflamed. Spleen enlarged to twice or thrice its natural size, and edges rounded. In ox from 3 lbs. to 7 or 10 lbs., in sheep from 2 or 3 oz. to 5 or 6 oz.

Sheep-pox.—The eruption begins like flea-bites, but ultimately resembles confluent small-pox, and the wool comes off. The flesh is pale, soft, and dropsical, with most disagreeable odour.

Tuberculosis.—"Grapes or pearls," frequent in cattle, less so in sheep or swine. The nodules, at first hardly visible, or like sago, may attain size of hen's egg. Most abundant on pleural surfaces, and usually appearing there first, may invade the lungs and glands generally, the liver, udder, &c. Their contents are cheesy, or softer in centre, grey or yellow. There may be cough, but that may be merely bronchitic. The disease is very common, especially among cows in towns, but the appearances during life are often too slight to attract attention. For a long time the animals may be apparently in good condition and yield the full amount of milk, though later they become emaciated and perhaps dropsical.

Joint ill.—(Acute articular rheumatism), known by lameness or inability to rise, the joints swollen and dropsical, fever, and perhaps abscesses. The flesh is watery, the joints inflamed, and if the animal have lain long on one side it will be darker than the other.

Swine fever, plague, &c.—In life the skin is either reddened generally or in patches (red soldier), or is marked with livid blotches (blue disease), or exhibits a pustular varioloid eruption. The redness penetrates the fat beneath. In the large, and less constantly in the small intestine are characteristic red spots, in size from mere points to patches ¾ inch across, which ulcerate, with ochreous crusts, ultimately falling off; lungs generally congested and solidified in parts.

But there is no relation, or if any, an inverse intensity, between the cutaneous and intestinal phenomena. The general symptoms are diarrhœa, and difficult breathing or cough. The flesh is not much altered, except in the reddening of the fat, which may be concealed by rubbing on salt, but appears when the outer surface is cut away.

Quinsey in swine. Strangles.—Swelling of the throat, neck, and perhaps fore-quarters, and the skin of the throat red or livid. There may be eruptions, ulcers, or sloughing inside mouth and throat. Breathing and swallowing are difficult.

Foot and mouth disease of cattle and sheep. An eczema or eruption of blisters, at first very small, but increasing to half the size of an egg and often running together in the mouth, extending to throat and nostrils; on the feet above the hoof and in the cleft. Those in the mouth burst leaving ulcers or abrasions, those on the skin form crusts. The hoofs may become loosened. The intestines may be involved, especially in sucking calves, giving rise to a condition resembling typhoid fever. The foot and mouth are not always affected equally. The flesh cannot be distinguished from that of healthy animals, and except in bad cases may be passed, though the head, feet, and udders should be seized, as should the whole carcase if there be signs of inflammation or abscesses. The milk, if unboiled, communicates the disease unchanged in its characters to man and other animals.

Hoof-rot of sheep may be mistaken for the preceding; but there are no mouth symptoms; the soft parts of the foot are inflamed, with greasy discharge, perhaps loosening or shedding of the hoofs, and even disease of the bones. Unless the inflammation have extended further, or the animal be seriously ill, the carcase excepting the feet need not be condemned.

Dropsy is only a symptom of disease of heart, liver, kidneys, &c. In simple accumulation of fluid in abdomen the flesh may be passed, but not so if it be wet and sodden, when it soon putrefies.

Parasitic Diseases of Sheep.

Rot in sheep. Due to flukes in liver and bile-ducts. If but few the carcase may be passed, if numerous, blocking up the ducts and causing jaundice, dropsy, and emaciation, with softening of the liver, it should be condemned. The fluke is shaped somewhat like a sole, is 1—1½ long, and ⅜ or ½ inch broad. Emaciation or dropsy, yellowness of the eyes, and falling of the wool are the symptoms during life.

Filariæ.—Thin worms ½ in. to 3 in. long found in lungs, in which they set up inflammation. As a rule the lungs only need be seized.

Parasites in Swine.

Cysticerci.—A stage in the life cycle of tape-worms. Bladders ⅛—⅜ inch in diameter, containing clear fluid and one or more pear-shaped bodies about the size of a small pin's-head. These, when the parasite enters on the second stage of its existence in the human intestine, will form the so-called head of the tapeworm. If the bladder (or cyst) be punctured, and the body examined under a lens, the four lateral suckers and the crown of hooklets will be seen. Pork much dried should be soaked in water to bring the cysts into view. It is vulgarly called "measly." In life there are mostly no symptoms to cause suspicion.

Trichinæ. Minute worms coiled in an oval sac or shell embedded in the substance of the muscular fibres, not, like the cysticerci, between them. The flesh is speckled rather than mottled as is "measly" pork, and may feel gritty when the cysts are calcified with age. A higher magnifying-power (as ⅛ inch objective) is required to define the worm, but the nature of the specks may be recognized with a good pocket-lens. The symptoms in bad cases are fever, pain, and emaciation, but in the great majority there are none to attract notice.

Both parasites may often be detected in a morsel of muscle substance from under the tongue. *Thorough* cooking kills them, and it is only in countries where ham or pork is eaten more or less raw, that human beings suffer from trichinosis, though the frequency of tape-worm shows that the interior of a joint often fails to attain the temperature requisite to destroy the parasite.

Accidental Death, &c.

Carcases of animals dying from or killed in consequence of injuries and accidents may, if properly bled, be perfectly wholesome. So, too, if slaughtered on account of imminent death from choking, "packing of the paunch," obstruction of the bowel (provided inflammation, *peritonitis,* have not set in), and cows or ewes killed or dying during parturition through hæmorrhage, the uterus coming down, or the calf or lamb becoming jammed. But if the animal be suffering from puerperal fever the carcase should most certainly be condemned ; the flesh will then be soft, wet and pale, or livid.

Immature Veal and Lamb.

"Slink" meat, or that of the young animal cast prematurely, or dying during or soon after birth, should be seized, but when after a few days the black slimy matter has passed from the bowels and the hoofs have hardened, it may be passed, for the lines drawn at three or four weeks, though good, are only arbitrary.

Poultry.

Should be firm and plump, the skin pink or yellowish, and strong. Stale birds are softer, blueish, greenish over the crop and abdomen, and have an unpleasant odour. Poultry are subject to "roup," the chief symptom of which is an offensive discharge from the nostrils and eyes, "gapes" or worms in the windpipe, intestinal worms, &c., but there is no evidence that the flesh of such birds is unwholesome. It is different with the so-called "Fowl cholera," though unfortunately if they are killed early and carefully dressed it is difficult of detection, unless the intestines can be examined, these being inflamed with red spots and livid patches ; the heart too is speckled and the liver soft. It may be rapidly fatal. The birds show marked signs of suffering, swaying from side to side, with wings drooping, feathers bristling, and combs flaccid and pale. They eat nothing, drink much, and usually have diarrhœa, at first glairy and foamy, and lastly streaked with blood. Fowls suffer also from tuberculosis, as do rabbits in captivity.

Fish.

Really fresh fish is firm, crisp, and almost rigid. The drooping of the tail when the fish is held out horizontally may be taken as a measure of "unfreshness." Much limp fish is sold in the streets, but if it exhibit no further change it would not be right to seize it. If it be actually softened in parts, or have a disagreeable odour it should be condemned. There is a parasitic disease frequently met with in salmon, a fungus or mould attacking first the gills and head; such fish should be seized. Mackerel are most apt to cause illness, but herrings, pilchards, &c., have given rise to symptoms of poisoning when to all appearances good, healthy, and in season.

There is abundant evidence that typhoid, enteritis, &c., may be caused by eating uncooked oysters, mussels, &c., and the inspection of oyster beds, begun by myself for the *British Medical Journal*, and continued by Dr. Bulstrode under the L.G.B., showed that many in tidal waters and on foreshores are exposed to contamination from sewer outfalls; while the clean deep sea and Dutch oysters are often stored in crates for some days in like dangerous places.

Milk.

The amount of milk given by a cow varies with the breed, age, and time since calving. It is also greater when the animals are kept in warm sheds, even though their health suffer from the bad ventilation. Perhaps the mean daily yield may be put at three gallons, though soon after calving it may be much more; that, however, of the first week, the "beestings," cannot be sent to market, it is of a rich yellow egg-like colour and prone to clot.

The sp. gr. of milk varies between 1025 and 1035, but is no test of quality, for being the resultant of the opposite tendencies of the fat to make it lighter, and of the sugar and casein to make it heavier than water, it depends on their relative proportions rather than their actual percentages. Thus an excess of cream lowers the sp. gr., which is raised by skimming, and might be restored to its original point by watering. The demand for an unreasonably high sp. gr. has been known to necessitate the removal of some of the cream. When the milk has stood some hours the cream rises, leaving the liquid whiter and less opaque. The cream forms from 2 to 25 per cent., mostly 6 to 12 per cent., of the volume of the milk.

Cream must not be taken as identical with the "milk fat," or butter. The whole of the fat does not separate as cream, even when aided by appropriate changes from hot to cold, but the "separator" removes almost every trace. Separated milk is as regards the fat just so much poorer, but being fresh and sweet is more wholesome, especially for children, than the souring "skim milk." There is, however, reason to believe that "separated milk" is used to dilute or adulterate whole milk. This is very difficult of detection, since all the constituents of the milk remain unchanged except the fat, which is naturally the most variable. "Fore-milk" and "strippings," or the first and last drawn at the same milking, differ widely, the former having the minimum and the latter the maximum of fat, sometimes resembling cream. As to fore-milk it is so poor, that it has formerly been used to rebut a charge of dilution, by being drawn in the presence of the magistrate as a sample of pure, though poor, milk; poorer than that which had been condemned.

The depth of the layers of cream rising in the same time on different samples of milk is by no means an indication of their relative richness, depending as it does partly on the size of the fat globules, and partly on the progress of the change of which it is the first visible evidence. If milk is chilled, or as is sometimes said "killed," by passing it over a refrigerator immediately after it has been drawn, the souring and consequently the rising of the cream is delayed for 24 hours on the average. Milk that has to be sent any distance by rail or road should invariably be well chilled, otherwise the agitation, especially in warm weather, will not only hasten the souring but may lead to the development of a poison, producing vomiting and purging.

Pure, clean, and healthy milk is slow to turn; the flavour though acid is at first not disagreeable, and the curd forms a uniform custard-like mass, the "sauer milch" of Germany. But that of unhealthy cows, of those kept in close town sheds, and of such as are fed with brewers' or distillery grains and wash, or with ensilage, or milk that has been mixed with foul water or exposed to foul air, turns sour rapidly, acquires a disagreeable taste and smell, and yields a ropy or flocculent curd floating in sour whey. The fine black sediment so often seen at the bottom of milk-vessels is mostly composed of cow-dung washed off the udders in the process of milking. In Germany and Denmark milk is often filtered through sand. It may also be due to dust entering the churns during transit by rail.

The only adulterations of milk at present are dilution with water and the addition of preservatives, almost constantly employed by small dealers who cannot, like the large dairy proprietors, put their surplus milk every night through a separator for turning it into butter. Boric acid and salicylic acid and carbonate of soda were the basis of most preservatives, but formalin is now much used. A constant watch should be kept on the small shops and street hawkers, and samples frequently sent to the analyst.

Milk and Disease.

Milk from cows suffering from foot and mouth disease, and from "garget" or inflammation of the udder, soon sours and becomes ropy; it may have an unpleasant smell, and contain blood, pus, &c. Foot and mouth disease is communicable to persons drinking the milk, as eczema of the mouth, face, and hands, with, in young children, a form of pneumonia. Boiling destroys the infection; but all such milk is unwholesome, and when there is any disease or eruption of the udders the milk should also be deemed unfit for human food. That from tuberculous cows cannot be recognized by its appearance, but there can be no doubt as to the use of such milk being the chief cause of the increasing prevalence of intestinal tuberculosis among infants, and its sale should not be allowed.

Human Diseases propagated by Milk.

Whether we are as yet in a position to assert that cows are susceptible of human specific diseases, as scarlatina, diphtheria, and enteric (typhoid) fever, in modified forms is *sub judice*, but there can be no doubt that milk (which constitutes an admirable culture fluid for most bacteria) may be a vehicle for transmitting these diseases, the germs being derived from the persons of the milkers, the inmates of the dairy, or, in the case of enteric fever, from water specifically infected, and used in the dairy for any purpose connected with the milk. In all such cases § 4 of the I.D.(P.)A. should be put in force, and the sale of the milk prohibited. Milk may absorb septic matters from foul effluvia in its vicinity. The sanitary surroundings and conditions of the yard and dairy are therefore of the utmost importance, and the milk should never be exposed to smells for a moment longer than is absolutely unavoidable, especially when warm from the cow. All milk that turns rapidly should be suspected, and all that is in the least stringy or slimy condemned. An unnatural blue or more rarely a pink hue is caused by low organisms of a fungoid nature, and such milk is unfit for food.

It is believed that in minor forms of disease or pollution the butter is not dangerous. The chemical and microscopical examination of foods devolves on the analyst, but every Inspector should be able to recognize gravely diseased or unsound articles.

Corn and Flour.

Corn is liable to several fungous parasites. Bunt, chiefly in wheat, and Smut, more often in barley and oats, are seen as fine dark powders, the former having a greasy feel and unpleasant odour, the latter finer and without smell. Ergot, chiefly in rye, causes the grain to assume the appearance of a huge carraway seed, full half an inch in length. They may all be detected in the flour by their colour, and recognized under the microscope. Ergot is by far the most poisonous.

Flour should feel smooth to the touch, not lumpy or gritty: when compressed in the hand should show some cohesion, be faintly acid to litmus paper, but not to the taste. Flour may be (1) bad or damaged from being made of diseased corn, with the fungi above-named; (2) be damp, when it is liable to become mouldy, and to give a characteristic odour; (3) become acid, with sour smell and taste, and gritty feel; (4) or undergo putrefaction, moist, discoloured, and offensive. Adulterations whether with cheaper flours or with mineral matters are rarely to be detected by the eye.

Various Forms of Starch Grains.

It is very important to be able to recognize under the microscope the various forms of starch cells, since most of the adulterations of flours and farinaceous foods consist in the substitution or admixture of other and cheaper kinds. Thus potato and rice are largely used in place of the more costly starches known as arrowroots, and may under certain circumstances be added to wheaten flour.

Wheat starch.—The most striking feature is the inequality of size, the largest granules being as much as ·0011, and the smallest not more than ·0001 of an inch in diameter. The larger granules have a central spot or hilum and faintly marked concentric rings, while the smaller are seen under a high power to be distinctly angular.

Barley starch.—The granules are very similar in size and appearance to those of wheat, but the larger are more irregular in form, and their rings more distinct, while the hila are either round or linear.

Rye starch presents the same variety in size, but the larger granules are still larger and more flattened; the hila are stellate.

Oats.—The granules are much smaller than the preceding, and more uniform in size, ·0001 to ·0004 of an inch, polygonal, and only a few of the largest have a hilum.

Rice starch.—The granules are still smaller, ·0001 to ·0003 polygonal, and with almost imperceptible hila.

Potato starch.—The granules vary greatly in size and form, some being small and circular, but others, and those by which alone it is recognized, large and oyster-shaped, with well-marked concentric rings, a very clear though small hilum at the narrow end, and occasionally another at the broad end.

These two last, viz. rice and potato starches, are those most frequently employed as adulterants.

Arrowroot.—This name was at first applied to the rhizome of the *maranta arundinacea*, from its supposed power of counteracting the effects of poisoned arrows, but is now used to designate almost any kind of fine and pure starch, prepared in such a manner as to be capable of substitution for that of the *maranta*, especially those obtained from the *Curcuma angustifolia*, *Tacca oceanica*, *Canna edulis*, and certain species of *Smilax*.

All these starches may be rightly called arrowroots, but the substitution or admixture of potato, sago, tapioca, etc., must be considered as adulteration.

Arrowroots are sold under a variety of names, as Bermuda, St. Vincent, East Indian, Sierra Leone, etc., but these titles are misleading, being applied indiscriminately to the products of different plants, or to that of the same plants grown in different places. It would be much better that they should be compulsorily distinguished as Maranta, Curcuma, Canna and Tacca arrowroots.

Their microscopic appearances are fairly characteristic.

Maranta.—The granules are more or less oblong or ovate, but many are mussel-shaped or irregular; the rings are delicate but well defined; the hila are sometimes round, but most frequently present the appearance of a sharply marked transverse line or slit, by which maranta starch may always bo identified without difficulty.

Its behaviour with boiling water differs also from that of other starches, the granules swelling to 20 or 30 times their original size. The markings are effaced, and the contents at once escape, forming a uniform gelatinous mass.

Curcuma.—The granules vary in size, but the larger greatly exceed those of the maranta in magnitude. They are flat, elongated, often gibbous or constricted. The concentric lines form segments only of circles; and the hila, which, if present, are at the narrow end, are very indistinct and often absent.

Canna (called also *Tous les mois*).—The granules somewhat resemble those of the potato, but are very much larger and flat; the striæ, too, are more numerous, regular, and distinct.

Tacca.—The granules resemble those of sago (which see), but are smaller. They are truncated or wedge-shaped at the end, but appear circular if seen endwise. The rings are indistinct, and the hilum circular or fissured.

By East India arrowroot is generally meant tho product of the curcuma, and by West India and Bermuda, that of the maranta, though this is also cultivated in the East Indies. South Sea arrowroot is mostly the product of the canna.

Sago is prepared in Sumatra and other islands of the Eastern Archipelago, from the pith of several species of palm belonging to the genera *sagus* and *saguerus*. It is imported *viâ* Singapore in the form of meal or flour, the latter being washed and bleached or granulated. A granular sago is manufactured in Germany from the flour or from potato starch. The granules are large, truncated, with wide bases, indistinctly ringed, and with a more or less stellate hilum at the apex. Those of granulated sago are much altered by heat, and their features greatly obscured by the manipulations to which the starch is subjected.

Tapioca or *Cassava* is obtained from several species of *Manihot*, a genus of Euphorbiaceous plants, natives of Brazil, one of which yields a bitter poisonous juice, which is washed out in the preparation. The granules resemble those of sago, but are smaller, and often adherent in groups; the hila are distinct, and mostly, but not always, circular.

The granules of all starches obtained from leguminous plants, as peas, beans, and lentils, are uniform, with a longitudinal branching hilum. Their form may be compared to that of coffee beans, and is quite characteristic.

Detection of Alum in Flour and Bread.

The quantitative estimation of alum is possible only by means of an elaborate analytical process, but it is easy to determine the presence of the adulteration in either flour or bread by the logwood test, and in flour by shaking it up with chloroform. If a sufficient quantity of the flour to be examined be agitated with chloroform in a large test tube, and then allowed to stand for some time, the alum being insoluble in that liquid is deposited at the bottom of the tube, while the flour, from its lesser specific gravity, rises to the top. The sediment may then be examined under the microscope, and also submitted to the ordinary tests. It should consist only of siliceous and calcareous matter from the millstone, and mineral matter of various kinds.

For the logwood test 5 grams of the chips are exhausted by steeping in 100ccs. of strong alcohol, and 15 grams of pure carbonate of ammonia are dissolved in 100ccs. of distilled water.

In the case of flour a small quantity, say 5 grams, is made into a thick paste with 5ccs. of water, 1cc. of the logwood tincture is added, quickly followed by the same quantity of the ammonia solution. If the flour be pure the colour will be pink, soon fading to a dirty brown; if alum be present it will be lavender or blue, the bluish hue increasing in depth with the amount of alum.

To apply the test to bread a quantity of the crumb is broken up in distilled water, and allowed to stand for twelve hours. The water is then strained off, and the test solutions added, or a slip of pure gelatine having been introduced at first is withdrawn at the expiration of the twelve hours and dissolved in the mixed test solutions, which will exhibit a pink or blue colouration according as alum is absent or present. This test is not absolutely distinctive of alum, but as it is by far the most probable adulterant, it affords at the least strong presumptive evidence.

All corns, seeds, and flours are liable to the attacks of weevils, acari, &c., which or their excrement will be visible.

Seizure of Unsound Food.

The M.O.H. or S.I. may at any reasonable time, Sundays included, inspect and examine any food exposed for sale, or deposited in any place presumably for the purpose of sale as, or preparation for, human food: and if it appear to him to be unsound or unwholesome, he may seize it and carry it, or cause it to be carried away to be condemned by a magistrate; but he must not destroy it himself. If obstruction be offered to his examination or seizure, he may take out a summons. This is equivalent to a right of entry, though such right is not expressly given. If he have reason to suspect that unsound food is kept or concealed on any premises, he may obtain from a J.P. a warrant to enter such premises, search for and carry away unsound food, to be dealt with by the J.P. Obstruction in this case is penal; but there is no penalty beyond the destruction of the articles if they were not actually exposed for sale.

The actual purchase of *Samples for Analysis* may be made by any one, but the officer must be at hand and enter the shop immediately. He must tender the money, and state that he takes the article "*for examination by a public analyst*"—*this is imperative;* he must then offer to divide it into three portions, securely sealing each, and offering one to the vendor; or if the vendor decline, into two; one for the analyst, and one to be retained by himself. Refusal to sell is *ipso facto* an offence against the S.F.D.A., provided the quantity asked for be reasonable. Milk may be taken in the street or at the Railway, though no vendor be present.

Quantities of several Articles of Food which the Inspector should buy for Analysis, and Division into Three Parts.

Bread, 4 lbs.; Flour, 2 lbs.; Tea, Coffee, Chicory, and Mustard, ¼ lb.; Pepper, 2 oz.; Vinegar and Spirits, 1 pint; Beer, 1 gallon; Aerated Waters, 3 bottles; Milk, 1 quart; Butter, 1 lb.; Lard, ½ lb.; Drugs, generally 4 ozs.

ESTIMATION OF FAT AND OTHER SOLIDS IN MILK.

Numerous processes have been practised or proposed, but they are mostly modifications of three distinct methods. The extraction of the fat by means of ether or carbonic sulphide from (1) the dry residue; (2) from the fluid milk, the fat having been saponified by an alkali; and (3) from the fluid milk, the casein and sugar having been previously destroyed by strong hydrochloric acid. In every case the total solids are determined by evaporation of a measured, or better, of a weighed quantity of the milk, and for all ordinary purposes it is unnecessary to distinguish between the casein and the sugar; the determination of (*a*) the total solids, (*b*) the fat, and (*c*) the solids not fat being sufficient. It is better to deal with small than with large quantities of milk, for in the prolonged exposure to heat required by the larger the residue undergoes changes. 5 ccs. or better 5 grms. are enough.

(1) Evaporate 5 grms. to dryness in a platinum basin and weigh while hot for the total solids. Evaporate a like quantity, stopping short of complete expulsion of the water. Triturate this repeatedly with warm ether, using a glass rod, filtering the washings over a beaker. Then cut up the filter, steep the pieces in ether, which add to that in the beaker. Evaporate the ether and weigh; by deducting the weight of the beaker that of the fat is obtained, and this deducted from the weight of the total solids gives that of the solids not fat.

(2) The second method or Soxhlet's requires a special apparatus, and the percentage of fat may be estimated by tables from the sp. gr. of the ethereal solution.

(3) But the third, or Schmid's process, is in every way preferable, for the extraction from the dry residue is always incomplete, and Soxhlet's method has other defects. In Schmid's process 20 ccs. of milk with 20 ccs. of strong hydrochloric acid are shaken together in a special form of tube and cautiously brought to the boiling-point, when the solution acquires a deep brown colour, from the conversion of the sugar into maltose, and becomes perfectly clear, excepting a small floating coagulum of lacto-albumen or pepton, the casein having been transformed into the uncoagulable acid albumen. It is then cooled under a cold water tap, shaken up with 25 to 30 ccs. of ether, and left to stand for about fifteen minutes. A portion of the ether dissolves in the watery solution, but the whole of the fat is contained in the floating layer, the coagulated lacto-albumen resting on the plane of contact between the ether and the brown subjacent liquid. An aliquot part of the ether is then carefully removed by means of a pipette, evaporated, and weighed. If an attempt

were made to decant off the whole of the ethereal solution the coagulum of lacto-albumen would be disturbed.

Gerber's process is even better for routine estimations. Ten ccs. of sulphuric acid (s.g. 1·82) are measured into a graduated tube, then 1 cc. of amylic alcohol (s.g. 0·815), and lastly 11 ccs. of the milk, each being slowly floated on the other. After a short rest, the liquids are mixed by gently swinging the tubes, which are then successively stood for ten minutes in water at 140° to 170° F., rotated for three minutes in a centrifugalizer worked by hand, and returned to the water bath for five minutes, when the percentage of liquid fat is read off and doubled.

Butter.—The essential constituent of butter is the fat of milk, which is always accompanied by serum albumen, but there is also a variable proportion of water and of salt. The percentage of water varies from eight to eighteen and of salt from one to ten.

But however it may depreciate the quality of the butter, excess of water or of salt is not legally an adulteration, the only recognized fraud being the substitution or admixture of "margarine," a refined fat, the absence of which is determined by the high specific gravity, and perfect homogeneity of pure butter, and the large proportion of fatty acids volatile at 100° C.

(1) The specific gravity of genuine butter rarely falls below 910, the usual range being from 911 to 913, that of the ordinary animal fats being between 902·8 and 904·5.

(2) The presence or absence of foreign fats is determined by viewing a thin film of the "butter" under a low power by transmitted polarized light; when, all extraneous light having been excluded, and the polarizer turned round until the field is dark, the butter, if pure, will be seen to be perfectly opaque.

If, however, any foreign fats be present, their crystalline structure reflecting the light in different directions will give a frosted or spangled appearance to the mass, and the proportion may be roughly estimated by the coarseness of the coruscation.

(3) The quantitative analysis consists in the determination of the volatile fatty acids, *i. e.* of those lower terms of the series, as the butyric, which distil over at 100° C.

The actual percentage is then calculated by saponifying the fat with caustic soda, breaking up the soap with sulphuric acid and distilling over a water-bath. The distillate, consisting of butyric, caproic, and other more volatile acids, is titrated with decinormal solution of caustic soda. It is estimated thus:—Pure butters, 2½ grams, never contain less than the equivalent of 12 ccs. of the soda solution, and may yield enough to neutralize 18 ccs. Other fats contain so little that the difference between this and the actual yield may be taken as representing the per centage of foreign fats added. As the sample thus examined has been previously melted and filtered it is water free, and consisting of fats only, the percentage of foreign fats, the presence of which is shown by the polariscope, is inferred from the titration.

Milk, cream, butter, and other perishable foods are largely treated with boric or salicylic acids or "formaline," *i. e.* formicaldehyd. Proceedings must be taken under § 6 of the S.F. & D.A., not § 3, to which the defence will have recourse.

Coffee is adulterated with chicory, and occasionally with ground beans, acorns, and date-stones.

A preliminary examination may be made by shaking the suspected articles in a test-tube with cold water, the coffee floats for some time, while the chicory sinks and rapidly discolours the water. This test is thus roughly quantitative. But examination under a low power of the microscope is conclusive. The structures of the coffee-bean are (1) small angular cells, containing oil globules and granular matters. In roasting, their outlines are obscured, and the oil is diffused, while the contents are shrivelled up. But the long oblique fusiform cells of the delicate membrane in the cleft of the bean are characteristic. Chicory is known by its large oval cells, with a very small mass of granular contents adhering to one side, but the laticiferous vessels with scalariform markings are unmistakable.

Cocoa.—The cheap and fancy cocoas are largely mixed with starch and brown sugar, for the purpose of "increasing the bulk," additions which, if carried beyond a reasonable point, constitute adulteration. A mixture of starch and sugar, with 10 to 20 per cent. of cocoa, is not "of the nature or quality" expected by a purchaser asking for "cocoa."

Sweets are now very rarely coloured with poisonous pigments, but it is still advisable occasionally to examine those sold to children, especially if "gilt" or "silvered."

Beers are examined for salt, alum, iron sulphate, and cocculus indicus, or picrotoxine.

Wines.—Elder and phytolacca berries are used to deepen the colour of port; logwood is added to port, burgundy, and claret, and aniline red when a brighter tint is required. Italian, Hungarian, and the less "vulgarized" German wines are among the purest. Australian and Californian have not escaped the arts of the mixer, and many French, Spanish, and Rhine wines are almost wholly fictitious.

Spirits as to alcoholic strength, though dilution is certainly not hurtful. The strength of these undiluted is approximately—Brandy 45, Whiskey 50—60, Gin 40, Rum 50—70%.

SANITARY ARRANGEMENTS OF HOUSES.

Essentials of House Sanitation.

Prevention of Damp.

(1) *Free* ventilation of the space between the ground or basement floor and the soil beneath. One or two "air-bricks" are a sham and a cheat. The openings cannot be too large or too many, and must be on more than one side; but a shaft or communication with a dry area or chimney adds immensely to the efficiency of any other lower apertures.

(2) Preservation of walls from damp. Absolutely necessary is a real damp-proof course above the level of ground, but below the lowest floor. Vitrified or glazed stoneware bricks make the best; but a thin layer of slate, or felt and tar, is a sham, and should not be passed. Slabs of good artificial stone or fine concrete answer well.

Where there is no area, the part of the wall below and for two feet above the ground-level should be double with binding or tie-bricks, and the space ventilated with air-bricks. Existing walls exposed to splashing drip or weather should be faced with asphalt or concrete, or with good Portland cement on the outside and perhaps the inside also.

(3) Though in the cheaper class of dwellings one must be satisfied with free ventilation of the space beneath the floor, it would not be unreasonable to require the foundations to be laid in concrete; that is, the footing of the walls to be imbedded in, and the entire area covered by the house laid with, concrete six to twelve inches thick. No better means could be devised to exclude rising damp or the exhalations from the soil being drawn up into the house. The prime cost will be recouped by the better preservation of the walls and flooring, apart from the gain in health and comfort.

In villages, porous brick floors laid on the earth should not be allowed in new buildings. If not constructed as above described, the floors should be of *glazed tiles* set in concrete, so as not to absorb damp when washed.

Construction of House Drains.

House drains should be made with glazed stoneware pipes, well jointed with cement, so as to stand the water test. The pipes should not be too large: 4″ to 6″ is enough for all but asylums, monster hotels, &c. If they must pass under the house they should be laid in a bed of fairly fine concrete or asphalt 18″ to 24″ square, in cross section; outside of the house well puddled clay will generally be sufficient, unless the soil be loose and sandy, when a coarse concrete is better. Iron pipes are objectionable, being liable to corrosion by sewage. At any change of direction of a drain outside of the house an inspection-chamber, or at least a lamp-hole between two chambers, should be fixed so as to avoid opening up the ground to remove stoppages.

Ventilation of House Drains.

Without a free current of air from end to end of every drain, no trapping will exclude foul gases from the dwelling. This ventilation may be effected in several ways according to circumstances.

(1) The best plan is to have at each end of the drains an interception and inspection-chamber, into one or other of which all branch drains must enter. These chambers must be provided with movable but air-tight covers. From that at the head of the drains an upcast ventilating shaft, a 4″ cast-iron pipe, lead-jointed, is carried up to some distance above the roof, far removed from windows, and surmounted by a proper cap. On no account should any communications be made with it, nor should a rain-water pipe be utilized for ventilation. A shorter upcast or inlet shaft should be connected with the other interception chamber, and it may conveniently be built into the outer wall of the front area. Between it and the sewer a siphon-trap should be interposed. If any branch drains cannot conveniently be brought into either of these terminal chambers, one or more intermediate chambers may be constructed for the purpose of receiving them, provided always they be outside of the building. Such chambers should not be ventilated, since the current of air would be broken by the interruption. The soil-pipe of lead or iron should be carried like the upcast ventilator above the roof, and end below in either interceptor, or in a smaller one, or gulley, ventilated by a grid, and communicating like the others with one of the chambers. The wastes should not lead directly into these chambers, but be disconnected by gulleys; that of the scullery waste being of the form known as a grease-trap fitted with a sludge-bucket, as should be stable-yard gulleys, in order to prevent the passage of dung and litter into the drains; and the system may be completed by an automatic flushing-tank at the head of the drain.

The mica valve now in vogue is, to my mind, of doubtful utility, being apt to get fixed either open or shut by dust and cobwebs; or, if acting, to remain closed, preventing all ventilation so long as winds from certain quarters cause a down draught in the soil-pipe, as in smoking chimneys.

(2) In smaller houses expense may be saved, without any sacrifice of efficiency, by utilizing the soil-pipe as the upcast ventilator, or the chamber at the head of the drain may be

dispensed with altogether, and the drain made continuous by an easy bend with the soil-pipe.

(3) In still poorer property it is permissible through necessity to reduce the single intercepting chamber to a stoneware intercepting gulley, such as has been recommended for receiving soil-pipes, which, if all other waste-pipes and rain-water pipes are disconnected by being cut off over gulleys, will still secure the indispensable condition of a through current of air.

(4) A method of ventilating the house drains which finds favour in America and Germany, where, too, the severe and prolonged frost renders open gulleys inadmissible, is to make the soil-pipe the inlet or downcast, by carrying the other to a considerable height above the roof, while the soil-pipe only just surmounts the eaves, or *vice versâ.* Inspection and disconnection from the sewer are provided for as usual. It is urged that there is no possibility of an escape of foul air near the ground.

(5) Mr. Weaver and a few others would carry the soil-pipe and house drain into the sewer with no siphon or disconnection of any kind, and the same principle was adopted by Col. Waring. Inlets are made in the sewer which is ventilated through the drains and soil-pipes of the houses. This arrangement is theoretically good, and, though safe enough in the case of Waring's "separate" pipe sewers, automatically flushed several times a day, is most hazardous under all ordinary circumstances, since the smallest fissure in the jointing of the pipes will open direct communication between the air of the sewer and the dwelling.

Rain-water pipes and those receiving in a hopper the water from bath, &c. wastes should be fitted below with a shoe to keep the wall of the house from being wetted, and in good houses the gulley should be enclosed in a fender to avoid splashing over the paving of the yard or area. The soil-pipe, whether disconnected as described above, or utilized as the ventilating shaft, should always be entirely outside the house, and carried as directly as possible to several feet above the roof, well clear of windows. Where expense is no consideration the best material is drawn lead, the lower four to six feet being enclosed in a cast-iron pipe for protection against injury. Otherwise iron, preferably Barffed, will do very well provided the joints are soundly leaded, not cemented, and that the junctions with the w.c.s are made by short-branched sections of lead pipe of the same size and bore. Soil-pipes are generally made too large, the smaller the pipe the greater the scour and the nearer does each discharge of water approach a *true flush.* Small pipes are thus *self-cleansing,* whereas large ones are apt to become fouled and coated with excrement. There really is no need to give a sectional diameter of four inches, as most architects require in specifications ; three inches is ample. Nor is there any obvious reason why the calibre of the soil-pipe should be enlarged in proportion to the number of w.c.s on successive floors served by it; for it is most improbable that they will ever be all used simultaneously; *more frequent* flushing being the only, and the very desirable, result. Provided that in such cases the unsiphoning of the traps in the branches below by the downward passage of a flush filling the lumen of the pipe, be guarded against by connecting each branch, at a point between the siphon bend and its junction with the stack, with a lead pipe 1½ in. diam. carried from the lowest branch to a point in the stack-pipe above the highest junction. The air above and below the descending column of water being brought into free inter-communication, no suction will be exerted on the water in the siphon traps.

Arrangement for Combined Drainage of Street Sections.

An arrangement very suitable for rows of houses of the poorer class, securing the utmost facilities for the removal of obstructions, would be, using the soil-pipes as upcast ventilators, to carry the house drains into a common pipe drain running along the rear of the block or row of houses, and having a manhole or inspection chamber at each end, with an ample inlet at the lower, between which and the sewer of the cross-street into which it discharges, disconnection should be established by means of a siphon, and it would not be difficult to arrange for automatic flushing if desired. The inspection chambers should be fixed in the footway of the cross streets, and if in laying out new streets the Sanitary Authority would retain as their property a paved pathway along the course of the common drain, giving at the same time access to the back yards, the necessity for entering on private premises for any scavenging purposes whatever would be obviated.

Water Closets.

In old houses the closet is frequently found in the middle of the building, with no communication with the outer air, an arrangement which should be absolutely condemned as "a nuisance and dangerous to health." But the usual position on a landing is unsatisfactory, for unless at the very top of the house the window acts as an inlet not an outlet, and any effluvia, however diluted with the incoming fresh air, are carried up the exhaust shaft formed by the stair-case and into the bedrooms, especially if fires be kept burning. No closet can be ventilated by a single window except into the house, and whether this will be harmless or offensive, or even "dangerous or injurious to health," depends on how it is arranged and kept.

In the dwellings of the poor, and where the persons using it, as servants, school-children, &c., are likely to be negligent or uncleanly, the closet should always be outside the house, though the approach should be paved, and may be raised and covered over but open at the side. In block-dwellings, workhouses, &c., the closets should be arranged, as in modern hospitals, one above the other, singly or in pairs, outside the main body of the building, and approached by a corridor or verandah entirely open on one side either at right-angles to or parallel with the main wall of the building. This arrangement is equally applicable to and to be recommended for houses of the better class, the open corridor being exchanged for an ante-room or lobby fitted as a lavatory or a conservatory, provided it be freely and constantly ventilated.

The form of the closet apparatus is a matter of such importance, in the dwellings of the poor especially, that it ought to be regulated by the bye-laws of the L.S.A., and the employment of certain patterns prohibited in new buildings, and in the refitting of existing ones. Such are the conical hopper which is always foul, and the pan closet, with its container and D trap. However clean the basin and pan be kept the container is always foul, and cannot be cleaned save by taking the whole apparatus to pieces, while the water in the D trap is never completely changed, and should the dip-pipe be corroded it ceases to act as a trap.

For the houses of the poor, for servants and the like, the best is the improved hopper, wide and upright behind, which, having only a siphon trap and no mechanical arrangement, may be used as a slop sink. For a better class, the "pedestal" hoppers are more elegant, and among these Jennings' "closet of the century," and Bolding's "Ladas," discharging their contents by a true siphon action, and having, unlike all other pedestals, a water area as great as in the best valve closets, are simply perfect; though where the most scrupulous care can be depended on, and the closet will not be used for slops, the "valve" closets, of which Bolding's "Kenon" and Tylor's are the best, would be preferred by many. "Wash-outs" are objectionable, for the "head" and force of the discharge being broken by the horizontal position of the basin, the excreta even if swept out of sight by the flush, which they are not always, generally lodge in the bend of the siphon until carried on by the next discharge, which is arrested in like manner.

A great advantage in the "pedestal" form is the absence of all wood-work and boxing, which provides a receptacle for dust and dirt. The valve closet is unsightly unless thus encased, and should be provided with a zinc or lead tray or "safe" to receive any splash or overflow, the waste-pipe from the safe having a hinged lid externally to prevent a cold in-draught. All closets used for emptying slops in the better class of houses should have a hinged mahogany seat to be lifted when so used.

An efficient flush requires a pipe of 1½ inch bore, and whether the volume is limited by the water company or not, it should be drawn from a separate cistern fixed at a height of four to six feet above the seat. "Water waste preventers," by which not more than a fixed quantity is discharged at one time, are insisted on by the metropolitan and other water companies; but where many persons use the same closet, and at certain times in close succession, those which take several minutes to refill are from a sanitary standpoint most objectionable.

Many patterns are extremely prone to get out of order. The conditions of a good closet cistern are—(1) That it shall refill in the shortest possible time; (2) that the discharge shall be forcible and *sudden;* (3) that the quantity discharged shall be the same under all circumstances, and not depend on the length of time during which the pull is held down. These conditions are as a rule best fulfilled by "siphon" patterns, which are also the least likely to get out of order. The basin should retain a considerable volume of water, of sufficient depth, and presenting as wide a surface as possible, so that the dejecta cannot fall on the dry sides of the basin, and the flush should in whirling round sweep the entire surface of the basin, rendering cleaning by hand unnecessary.

Sink Wastes.

Glazed stone ware sinks are lighter, far cleaner, and not more costly than stone. The waste pipes should be provided with a grid cemented in, and they should discharge over a gulley. In poor property the pipe should be nearly straight to avoid fouling; but in better houses should be fitted with a cast lead siphon trap having a screw cap removable for cleaning out the bend. On no account should sink wastes pass directly into the drains. Bell traps are worse than useless, are constantly being lifted to clear the way; out of doors they are frequently dry, and everywhere are liable to be broken or lost. Their employment should be prohibited by the S.A.

The Water Service.

The practice of carrying service pipes outside the house, where they will burst during frost, causing expense, annoyance, and illness, ought not to be tolerated. Cisterns are almost universally fixed in the most unsuitable places—on roofs exposed to frost in winter and heat in summer, as well as to the entrance of soil, leaves, insects, &c., or in dark confined spaces beneath the roof which are little better, and where proper inspection and

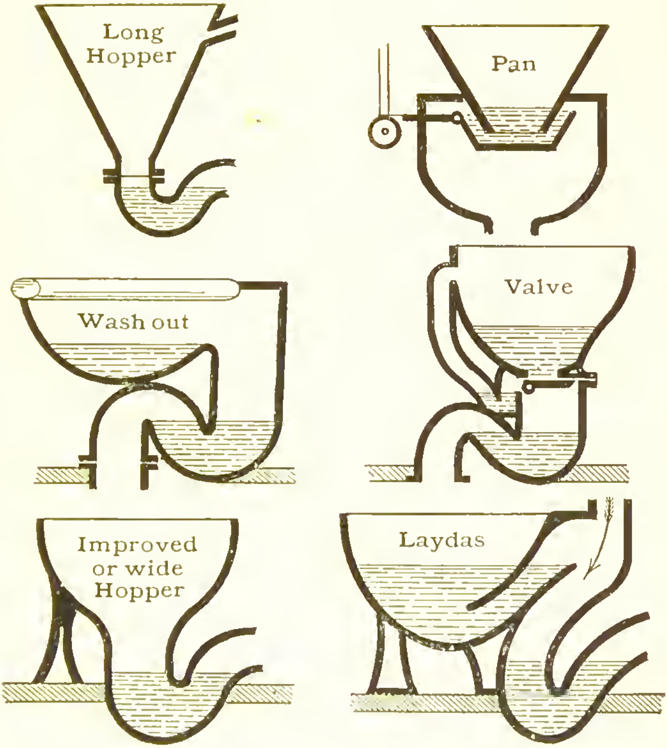

Plate IIIa.—Forms of Water-Closet Apparatus.

[*To face p.* 152.

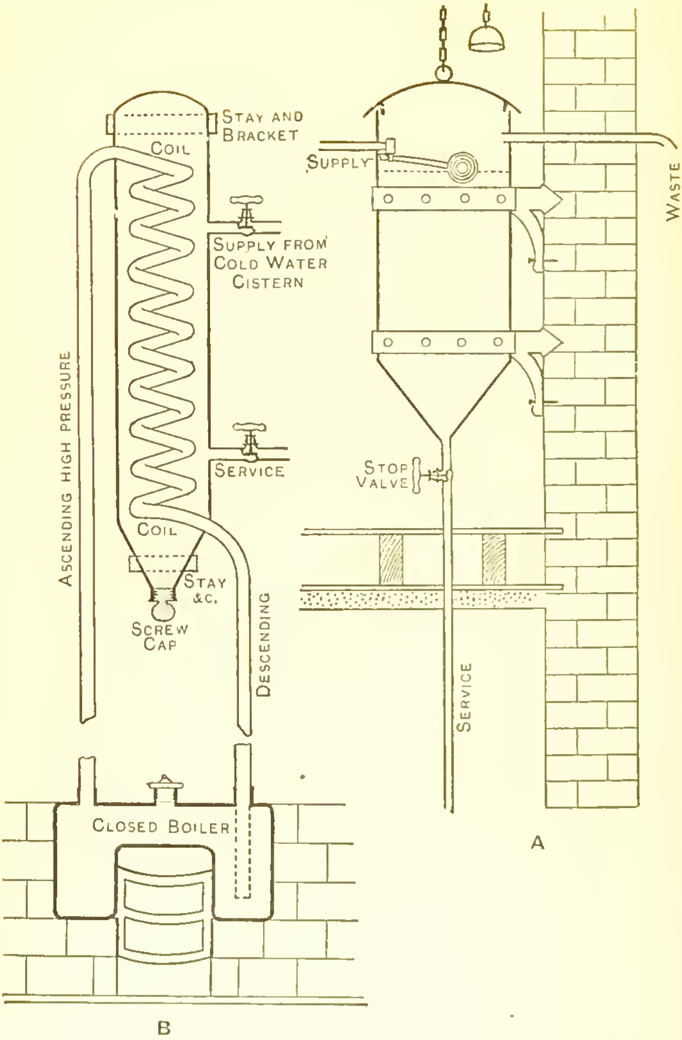

Plate IV.—Arrangement of Hot and Cold Water Service.

To face p. 153.]

cleaning is impossible, or under landings, in bedrooms, and even in water-closets.

The best place is a box-room not used for lumber, which if it contain the hot-water cistern also, would make a good linen-closet; or on a landing, though a light lofty roof space is tolerable, provided the cistern be easily inspected and covered by a close-fitting hinged lid, not as usual by loose boards. But an ideal cistern, never needing cleaning, would be a vertical cylinder of galvanized iron terminating below in an inverted cone, to the apex of which the service pipe should be attached, while the supply pipe, like the overflow, should be soldered or screwed in the side, and the cover a tightly-fitting lid like that of a saucepan with a flanged rim (Plate IV. A). The overflow must never be connected with the drains, but be a "warning pipe."

The crusting and ultimate occlusion of hot-water pipes is caused by the constant deposit of calcic carbonate from the continuous stream of fresh water, as on approaching boiling-point it gives off the free CO^2 that kept the lime salts in solution. In the cistern shown in Plate IV. B the water is heated by a steam coil, and any deposit in the conical bottom may be removed by unscrewing the cap at the apex, using a weak acid as vinegar to loosen the crust, though as the water in the cistern does not circulate it will rarely need to be raised so near boiling as to throw down its earthy salts. The coil was suggested to me by Captain Reck of Copenhagen, but the form of the cistern is a modification of my cold-water one.

Galvanized iron and zinc are the materials most used, but slate, jointed with cement, not red lead, and glazed stone-ware (Doulton's) are better. Lead is now rarely used for cisterns, though it has not yet been superseded for pipes. Ordinary waters have no sensible action on lead, protected as it soon becomes by an insoluble coating of lime salts, which should not be disturbed. But some do dissolve lead to a dangerous extent, among which are moorland and other waters charged with peat, and those from certain sands of the Hampshire beds.

In the houses of the poorer classes the objections incident to roof cisterns and the neglect of the tenants might be obviated by providing one large central cistern, well protected from frost and dirt, under the supervision of the S.I., whence all the houses in the block or street section should be supplied by a system of pipes.

Dust-bins.

The old-fashioned dust-bin is an abomination, and its place should be taken by movable receptacles, the so-called "sanitary bins," but in the case of small tenements with no access to the back yard except through the house, it would be a good plan to provide small pails, and to require tenants to put them out on the footway every morning for collection by the scavenger's cart.

Traps and Gulleys.

Very few fulfil the essential condition of being self-cleansing. All, the sides or bottoms of which form straight lines, angles, or wells, stand self-condemned except for the purpose of arresting sludge or grease. Siphons alone are admissible, and in these the curvature is a matter of importance. Those fixed in sink and bath or lavatory wastes should be what are called S traps, of cast lead. The practice of making a siphon by bending the pipe, inevitably narrowing its passage and leading to fouling, is thoroughly bad. They should have a screw-cap below to give access for cleansing and removing obstructions, and in the case of lavatory basins, the recovery of articles that have passed down when the plug has been withdrawn. Closet traps should be V traps, or Hellyer's Anti D, in which the ascending curve is pretty steep, otherwise a heavy flush may carry so much of the water before it as to unseal the traps, and the roof above the ridge is high enough to preclude the fæces from striking and adhering to it.

Drain interceptors should not be too capacious, and the fall of the flush as it enters should be as nearly vertical as possible, or the whole of the standing water will not be swept out at one time. In Buchan's, Hellyer's, Bolding's, and others of like form, the whole of the standing water is swept out in one wave each time a flush of ordinary volume enters, and with sufficient force to lift and carry over any solid matters.

DRAIN TESTING.

To ascertain the soundness of newly-laid drains, and to detect defects in old ones, no reliance can be placed on mere inspection, but the water or smoke test should be employed. All new drains should be submitted to the water test, sufficient time having been allowed to elapse for the cement joints to have set hard. From the furthest inspection chamber, or in an inferior class of work where such has not been provided, by leaving unlaid or by removing of one of the most distant sections of the drain pipes, a plug is introduced (the elastic bag stopper of J. Jones, 20, Sydney St., Chelsea, being perhaps the best, and applicable to siphons, &c.), the drain is then filled with water till it rises to the brim of the gulleys. If after two to four hours the water has not sunk, the drain is evidently water-tight; if it have, the leak must be found.

The smoke test may be applied by discharging a "rocket" at the lowest and distal end of the drain, plugging it so soon as the rocket has been lighted, and looking for the escape of the smoke; or by driving smoke in by means of a special apparatus.

This is not so searching as the water test, gases being compressible, but it may be useful in discovering the position of the leak through which the water escaped, and it enables one to detect defects in soil-pipes and others above the level of the gulleys. When it is applied the gulley and all siphons should be charged with water to prevent the smoke escaping through them, and the mouths of ventilating pipes be stopped with wet cloths. When it is not possible or necessary to open up the drain a stink test can be applied through a w.c. trap by special chemicals igniting when wetted.

Disposal of Sewage in Villages.

Though water carriage provides the only practicable method of removing excreta and slops from the midst of towns, the present tendency to construct costly systems of sewerage in villages and small towns with straggling streets and gardens attached to every house is certainly an error. The volume of the sewage is inadequate to maintain a proper flow, streams are polluted unless filtration through land is employed, and the excreta, for which ample use can be found, are simply thrown away.

The larger houses, the occupiers of which will have water-closets, should have at a distance from the dwelling, and well disconnected in the same manner as town sewers, an absolutely water-tight cesspit, lined with concrete, and ventilated by a low inlet and an upcast pipe against a wall or tree. The contents of this may be pumped over the garden ground or grass every week, or in summer oftener. But the best arrangement for cottages, is to have outdoor privies with portable receptables, large galvanized pails beneath the seat, removed through a door at the back for the weekly application of the excreta, pure or mixed with ashes, to the kitchen garden. Ashes are as good a deodorant as earth while quite inert. They have to be disposed of in some way, and where the soil is a heavy clay it is unfit for earth closets, and is benefited by the addition of the ashes.

Slops should be thrown directly on the land, especially on lawns or other grass. Should there be many houses without sufficient garden ground to utilize their own excreta, their removal should be undertaken by the L.A. or the owner of the property; such manure will find a ready sale among farmers.

Cesspits (with the exception above-mentioned) should be everywhere prohibited, as a danger to health and a source of almost inevitable pollution of wells.

River Pollution.

The universal pollution of our rivers and streams, rendering them everywhere dangerous as sources of water supply, destroying the fisheries, and in somo districts converting them into positive causes of disease, has of late assumed gigantic proportions, and become nothing less than a national question. It follows the growth of large towns, the aggregation of populous villages, and the development of industries, even in what would otherwise be rural and thinly-peopled districts. The present limited area of most sanitary districts makes it impossible for any one alone to check the progress of the evil; even county councils rarely exercise jurisdiction over a sufficient length of any river to make much impression, and Conservancy Boards pay more regard to the navigation than to the sanitary conditions of the water-ways under their control.

The pollutions consist of (1) the surface drainage and storm-waters from highly cultivated lands. (2) The crude sewage of villages, of the floating population, and of some towns, though the last are now very generally compelled to have recourse to some sort of previous purification; and (3) the waste water from factories of every kind.

In rural districts, where every house has its garden-plot, and excrement will always find a ready sale as manure, there is no excuse for sanitary authorities permitting the overflow of cess-pits into rivers, or the universal but culpable practice of draining yards, &c., into brooks, which after providing water for cattle, and not seldom for man, serve to feed the smaller rivulets and streams, transforming what might be crystal brooks into sluggish sewers. The treatment of the sewage of towns is discussed in another section, and falls under the cognizance of Urban S.A. and the L.G.B., but though crude human excreta are perhaps the most directly dangerous pollution of water considered as drink, from the presence not only of decomposing organic matters, but of the microbes of specific diseases, the discharge of the foul, acid, greasy and other waste waters from factories is, in the northern counties especially, the most fertile source of pollution of the worst kind. Indeed the water of some rivers, which not many miles higher up their course are pure mountain torrents, is often actually fouler than the crude sewage of the great towns which is allowed to pass directly into them.

The Rivers Pollution Act is a dead letter, for so long as the Sanitary Authorities and the Boards of Magistrates are largely composed of and dominated by the mill-owners and others by whom the pollution is brought about, the elasticity of the expression, "the best practicable means" for rendering the effluents innocuous, defeats the intention of the Acts; while standards of purity are utterly delusive, since they may always be attained in the letter by simply pumping water from the river to dilute the waste liquor before returning it to the stream, a procedure more dishonest than that commonly described as "robbing Peter to pay Paul."

The Factory department of the Home Office, the Board of Trade, and the Local Government Board ought to define from time to time what is the "best practicable means" for treating each kind of waste, and insist on its being universally adopted, until experts shall have demonstrated another and still better process: and there is no doubt that sources of profit, at present neglected through the apathy of the manufacturers, would be brought to light.

A few of the more important sources of pollution may be mentioned, with the remedies already known.

Cotton mills and weaving sheds.—The waste size, liquor from fermenting flour, &c., add largely to the putrescent organic matter in the water.

Chemical works do not as a rule give rise to such pollution as is generally supposed. Calcium chloride greatly augments the chlorine and hardness, but does not in any way favour putrescence.

Bleachworks are far worse; all the soda ash and bleaching powder used is ultimately discharged into the rivers, but the whole of the soda might be recovered with great pecuniary advantage by means of the Porion Evaporator.

In most places, and for all but the coarser work, spring water is used on account of its greater purity, but when fouled and rendered strongly alkaline, it is poured into the river, where it aids the putresence of the organic pollution.

Paper mills alone have to any very considerable extent adopted rational means for purifying their waste, which was formerly, and is now occasionally, inconceivably foul. But there are mills where twenty-four tons per week of soda ash, which had been passed into the river (together with sixty tons of putrescible organic matter), are now recovered by the Porion Evaporator, which repays the cost of erection within the first, or at the outside the second, year. The fact that paper mills are situated by preference on the banks of the purest streams, in the open country, aggravates the nuisance.

Woollen mills give the filthiest of all effluents, into the composition of which grease, alkali, dyes, mordants, and potash salts enter. They might, however, yield a considerable revenue, especially from the grease, which when purified constitutes the elegant basis of ointments and pomades known as Lanoline, and obtained at the suggestion of Prof. O. Liebreich from the waste of the Saxon woollen mills.

Dye and print works cause much pollution and discolouration, though the blackening of the stones must not be taken as a measure of the pollution, which is incomparably less than that caused by woollen, paper or cotton mills.

Tanneries.—The spent lime liquor, and in a somewhat lesser degree the tar liquor, contain large quantities of organic matter of animal origin, adding enormously to the free and the albuminoid ammonia of the water.

The following analysis of an effluent from some woollen mills on the Roche will give a faint idea of the pollution:—

	Parts per 100,000.	
Suspended matters	(*a*)	(*b*)
Mineral or fixed	417·2	273·0
Organic or volatile	1614·0	816·4
Total	2031·2	1089·4
Soluble matters at 100° C.		
Total soluble solids	1324·00	864·00
Ammonia	11·04	24·00
Albuminoid ammonia	6·99	7·20

The extent to which a river may be polluted by factory waste may be seen in the following analyses of the Irwell, the water of which is sometimes even fouler than crude sewage.

	River Irwell.					Sewage.	
	Drght.	Norm.	High water.	Flood.	Totlinton Brook in Drought.	Leeds Sewage.	Salford Sewage.
	Parts per Milln.	Parts per Milln.	Parts per Milln.	Parts per Milln.	Parts per Milln.	Parts per Milln.	Parts per Milln.
Suspended ...	26·0	164·8	132·7	679·0	342·2	899·0	12859·7
,, Fixed (mineral?)	10·7	70·2	96·0	505·4	237·2	224·0	3203·0
,, Votatile (organic?)	15·3	94·6	36·7	173·6	105·0	675·3	9656·7
Soluble solids ...	857·	728·6	528·8	314·2	4200·	1257·0	1371·4
Hardness ...	271·4	271·4	260·0	168·5	700·	271·4	231·4
Chlorine ...	117·1	106·5	55·7	25·2	471·5	139·4	456·4
Alkalinity in terms of (H^2SO^4)	196·	215·6	117·6	98·	490·	313·6	248·9
Ammonia ...	9·6	7·8	4·5	1·6	3·16	28·8	14·7
Album. Amm.	2·9	2·5	1·9	1·1	7·34	4·0	5·5
Nitrates ...	1·6	6·	1·2	·4	1·24	1·8	1·1
Absorbed Oxyg.	137·6	116·8	60·	28·4	1864·0	180·0	176·13

AIR.

Composition of the Atmosphere.

The *oxygen* never exceeds 21 per cent., nor falls below 20 per cent. Angus Smith found on Scottish mountains 20·99; in Hyde Park 20·95, in the crowded streets of tho East End of London 20·85, and in the closest courts in Manchester 20·18.

Ozone.—In the country, and still more on the sea, much of the oxygen exists in the allotropic or condensed form of ozone, but the tests commonly used are not trustworthy. Ozone papers are saturated with a solution of starch and potassium iodide, and the iodine liberated by the ozone gives rise to the characteristic discolouration, the depth of which is taken as indicating the proportion of ozone in the air. But unfortunately the same effects are produced by any body that has the like power of breaking up an iodide, and notably by sulphurous acid, nitrous fumes, and chlorine, which are most likely to abound where ozone is most constantly absent.

The presence of ozone indicates the absence of oxidizable and therefore of organic matters, especially in a state of putrefaction, on which it acts with great intensity; it is therefore evidence of the purity of the air, but it is doubtful whether it is directly beneficial to animal life, and in any measurable quantity it is actually fatal.

Carbonic acid.—A variable proportion is always present. In the country, where it is removed by the growing vegetation as fast as formed, it rarely exceeds 0·4 per 1000 and may be lower; and if much higher the air cannot be deemed pure. Angus Smith found in the country, and in the London parks 0·3, in the streets of the city 0·413 to 0·428, in Glasgow an average of 0·5, and in Manchester 0·4, but during a fog 0·679.

Ammonia is always present in appreciable but very small quantities, together with organic matters, that when washed out may be recognized as "albumenoid ammonia," by Wanklyn's process.

The air of marshes contains an excess of CO^2, *e.g.* 0·6, or 0·8 per 1000, also marsh gas CH^4, and perhaps H^2S, &c.

The air of graveyards does not contain any poisonous gases, unless burials have been improperly or negligently carried out, the soil and vegetation, of which the most rapidly growing should be preferred, absorbing all emanations before they reach the surface. The chief product of "orderly" decomposition in suitable soils is CO^2. But the effluvia confined in vaults, where, in the absence of earth, putrefaction takes the place of decomposition, and rising into churches, are a different matter.

The suddenly fatal consequences of descending into freshly opened vaults are, however, due in great measure to the CO^2 of the ground air, and strictly parallel to the like effects of descending into deep wells.

Sewer air, or more correctly "sewer gas," as Pettenkofer designates the emanations from deposits in sewers, contains CO^2, H^2S, $(NH^4)^2S$, and gaseous hydrocarbons, &c.

Poisoning from overcrowding, *i. e.* products of respiration, is called *ochlotic*, that from sewer gases and products of putrefaction is *mephitic* poisoning.

Sewer "air," *i. e.* the air of well ventilated sewers, so laid as to be free from deposits, differs little from that of the street. Sewer "gas," *i. e.* fetid effluvia, is the product of putrefactive changes in the deposits taking place in the sewer.

Impurities present in Air of Rooms.

Carbonic acid.—Pure CO^2 is fatal when present in the proportion of 50 to 100 parts per 1000, and severe headache, &c. may be caused in some persons by 15 to 20 parts, though in soda-water factories 5 to 10 parts are frequently present without any inconvenience to the workmen.

Respiratory carbonic acid.—The poisonous effects of "re-breathed" air are due not to the CO^2, except under extraordinary circumstances, but to the effete organic matter exhaled partly from the lungs and partly from the skins of the occupants of the room, to which may be added the CO^2 and other gases given off in the combustion of lamps of all kinds. But since the organic matter cannot be easily or accurately estimated, while the CO^2 can, and moreover bears a fairly constant ratio to the former, it is usual to distinguish the proportion present in excess of that in the outer air as "respiratory," or "organic" carbonic acid. The natural CO^2 may be taken as 0·4 per 1000, which is in fact a somewhat high estimate. Any further addition of organic CO^2 not exceeding 0·2 per 1000 is imperceptible to the smell, and may be considered innocent and unavoidable. Therefore ·2 or a total of ·6 is called the "permissible" impurity. When it exceeds this the smell becomes evident to a person coming in direct from the open air, 0·4 being close or unpleasant, 0·6 disagreeable, and 0·8 sickening, 1·0 is disgusting; but the nose is unable to differentiate further, though 3·5 or even more parts per cent. have been observed in schools, theatres, courts of law, &c. The sense is blunted by prolonged exposure to foul air, so that the observer must enter the room straight from the open air, or re-enter after at least a quarter of an hour's free respiration out of doors. The exhalations of unwashed persons are more offensive and probably contain more organic matter than those of the cleanly. Those of the sick are more fetid than those of the healthy. Dr. De Chaumont could perceive 0·166 in an ordinary medical ward, though 0·208 in the barrack-room was odourless. Warmth and moisture facilitate its recognition on first entering the room.

Estimation of CO^2.

Pettenkofer's method of estimating CO^2. A glass bottle, holding about a gallon = 4·5 liters, the capacity of which has been accurately measured, having been well washed and dried, is filled by pumping or otherwise with the air to be examined. Clear lime water, 60 ccs, is then introduced, and the bottle having been well agitated is set aside for six to eight hours. A rubber cork is preferable to a glass stopper. The CO^2 is calculated from the loss of alkalinity in the lime-water, as determined by a standard solution containing 2·25 grams of pure crystalline oxalic acid to the liter. One cc of this exactly neutralizes ·001 gram (one milligram) of lime, and water dissolves a little over that quantity in the cc.

The ccs of acid solution required to neutralize 30 ccs of the original lime water—those required by 30 ccs of that which has been exposed to the air in the bottle = the milligrams of lime neutralized by the CO^2 therein, and × 0·795 = ccs of CO^2 in the air examined, which = the capacity of jar − the ccs of lime water (say 60) introduced. The ccs of CO^2 ÷ corrected capacity of jar = parts per 1000 of CO^2 in the air. (The factor 0·795 is the expression of the ratios between the atomic weights of CaO and CO^2, and of that of CO^2 with its volume at zero ; doubled, since 30 only of the 60 ccs have been actually used.) To correct for temperature add 0·2 per cent. for every degree F. above freezing. Correction for pressure is rarely necessary.

Ex.—Suppose the capacity of the jar to be 4385 ccs, and 30 ccs of the lime water to be used. The volume of air examined would be $4385 - 30 = 4325$ ccs.

The alkalinity of the lime water itself was 39, and after exposure to the air in the jar 33 : the difference 6 representing the milligrams of lime converted into carbonate, which × the factor $0·795 = 4·77 =$ ccs of CO^2 in 4325 ccs of air. Then—

$4325 : 4·77 :: 1000 : x$, $x = 1·103$, *i. e.* the carbonic acid in a litre of air was 1·103 ccs, or 1·103 per 1000 parts.

To determine the moment of neutralization of the lime water by the oxalic acid volume, use good turmeric paper, observing the margin of the drop most carefully.

Estimation of oxidizable matters, and of free and albumenoid matter, see on Water Analysis.

Calculation of Requisite Supply of Air.

To determine volume of pure air requisite per hour to maintain the standard purity of not more than ·2 per 1000 of respiratory CO^2, or any other proportion deemed desirable or tolerable.

d = volume to be delivered per hour in cubic feet.
c = volume of respiratory CO^2 omitted per hour in cubic feet.
r = ratio of respiratory CO^2 aimed at or permitted.

$$\text{then,} \quad d = \frac{c}{r}$$

An average adult gives off 0·6 cubic feet of CO^2 per hour when at rest or at work not involving muscular effort; and children little if any less, their vital functions being more active. The standard purity of 0·0002 of respiratory CO^2 may not always be attainable, but with a reduced supply of fresh air the work done is lessened and the exhaustion increased.

During hard work the CO^2 given off rises to 0·8, or 1·0 cubic foot per hour.

$$\text{Ex.} \qquad a = \frac{0{\cdot}6}{0{\cdot}0002} = 3000.$$

$$\text{or} \qquad d = \frac{0{\cdot}8}{0{\cdot}0002} = 4000.$$

i. e. in an ordinary dwelling room, shop or workshop where the work is light 3000 cubic feet of fresh air should be supplied per head per hour, or in one where the work is harder 4000, but in forges, mines, &c. 8000 or 10,000 may be required. Under some circumstances and for short periods a lesser purity, *e.g.* 0·0003 or even 0·0004 may be tolerated.

From this formula, the possible delivery of pure air being known and the degree of purity agreed on, one may calculate the number of persons that may be permitted in a given room; thus let d = 25,000 cubic feet, c = 0·75 cubic feet, and r = 0·0003, x = number of persons in the workshop.

$$25{,}000 = \frac{0{\cdot}75}{0{\cdot}0003}\,x = 2500\,x.$$

$$x = 10.$$

Increased space per head does not lessen the need for supply of fresh air, simply delaying the period when the limit of impurity is reached. Its chief advantage is that the movement of the air is less perceptible, *i. e.* ventilation involves less draught.

Lights and Ventilation.

Lights must be taken into account. A cubic foot of gas gives off in combustion 2 of CO^2 and ·2 to ·5 grains of SO^2, and therefore requires 1800 cubic feet of air for proper dilution of its products. Ordinary burners consume 3 to 5 cubic feet of gas per hour, and therefore require a supply of 5000 to 9000 cubic feet of air, or as much as two or three adult men.

F. Fischer and Dr. Overdieck have proved that for a light of 100 German candles, the heat evolved is in thermal units:—Electric: Arc, 57 to 158, and incandescent or glow lights, 290 to 536. Gas: Batswing, 12,150; Argand, 4800; and Siemens' Regenerator, 1500. Petroleum, round wicks, 3600; flat wicks, 7200. The CO^2 given off is in cubic metres:—Electric lights and Siemens' gas, 0; Argands, 0·46; Batswing, 1·14; petroleum, round wicks, 0·44; flat wicks, 0·95. The cost in pfennings (100 = 1 shilling) of arc 6 to 12, and glow lights, 15; Gas, batswing 36, Arg. 14, Siemens' 8, and Welsbach 5; Petroleum, flat wick 11, and round 5; Colza, in reading lamp 67, in carcel 41; Candles, paraffin 140, stearin 166, sperm 270, and wax 310 per hour.

Movement of Air and Draughts.

Practically the amount of ventilation is limited by the movement of the air consistent with comfort. The warmer the air the less its movement is felt. The air of a room may well be renewed three or four times an hour, but six times cannot be exceeded without provoking unpleasant draughts. Thus, allowing 3000 cubic feet per head and 6000 per gas-burner hourly, so as to maintain the standard purity of 0·0002 of organic CO^2, and putting a complete renewal of the air of the room every 10 minutes as the utmost permissible, 3 men with 3 gas-lights would require a room 30 × 15 × 10 feet, or 25 × 15 × 12. A common fire-place extracts 3 to 6 cubic feet per second, a strong fire 6 to 8; and 6 cubic feet per second = 21,600 per hour, will, if the ingress of fresh air be free, provide ventilation sufficient for 7 persons, or for 2 or 3 with as many lights.

The movement of air of 55°—65° F.:—

(1) At 1½ feet per second (1 mile per hour), is felt by none.
(2) At 2—2½ ,, ,, is felt only by a few very sensitive persons.
(3) At 3 ,, ,, ,, by most.
(4) At 3½ ,, ,, ,, by all.
(5) At 4 ,, ,, a distinct draught.

(6) At 70°—75° somewhat higher velocities are less felt and the sensation is not unpleasant.

(7) Above 80°, or below 45°, currents of air are more felt and are less agreeable.

(2) is therefore best for cool air entering rooms.

(3) (Cf. 6) is appropriate when the air is warm, and when cool is not objectionable in workshops where the work is hard.

Cubic Space.

It is not desirable to change the air of a room more than 4 times, or in cold weather and with unwarmed air, than 3 times in the hour, unless the occupants are actively at work. One more change may be allowed then, or when the air is warmed to 70°; with both conditions 5 changes may be permitted. We thus see that allowing 2000 cubic feet per hour for children, 3000 for females, and 3600 for men at rest, 4750 for men at light and 9000 at hard work, the average cubic space per head in rooms of moderate size should be 1000 to 1200 under the former and 1500 to 2000 under the latter conditions. Rooms under 9 feet high are bad, but little is gained by exceeding 14 feet. The sick require more cubic space, 2000 to 3000 cubic feet, and fever or lying-in cases 3000 to 5000 at the least.

Floor space is scarcely less important, so as to permit of free circulation of air round each individual. In workhouse wards occupied during the 24 hours, the regulation space is 80 square feet: in those occupied by day or night only 50 square feet.

Legal and other allowances of cubic space per head.

	Cubic Feet.
Common lodging-houses	240 *
Poor law for healthy persons	300
Poor law for the sick	850—1200
Barracks (too little)	600
Army Hospital wards	1200
Army Hospital huts (freer ventilation) ...	600
London Board Schools ... ... (10 square feet floor space, 13 feet height.)	130 †
Education Act for Schools ... ... (8 square feet, 10 feet height.)	80 †
Bye-laws of some London parishes for lodgings occupied by day and night	400

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* Not enough, but more than the same class of persons would obtain elsewhere.

† Grossly insufficient.

	Cubic Feet.
Bye-laws of some London parishes for lodgings by day or night only	300
Canadian Schools	240
Factories (held as a rule) not less than ...	250
Seamen's cabins (Merchant Shipping Act) ...	72[*]
Canal Boats Act, 1877 (irrespective of number of occupants): After cabin	180[†]
Fore cabin	80[†]
In ordinary Hospitals	1200—1500
Fever and Lying-in Hospitals	1500—3000
For dwelling-rooms see above, but generally ...	1000
Or allowing for lights	1500

	Square Feet.
The floor space in ordinary hospitals should not be less than	100—120
But if clinical classes be held	200—250
In Fever and Lying-in Hospitals and Surgical wards	200—300

Animals.

Horses and cows require for health 10,000—20,000 cubic feet per hour, and for the minimum cubic space 1200—1800, but if cowsheds be practically open 1000 may suffice.

Density, Humidity.

The mean weight of a column of the atmosphere at sea-level and zero (freezing-point) is equal to that of a similar column, *i. e.* one having the same sectional area, of mercury 30 inches (799 mm.) high, that is, it exerts a pressure of 14·7 lbs. on the square inch. A cubic foot then weighs, when dry, 566·85 grains.

Air, like other gases, expands with heat 0·00203 of its volume for each degree F., or 0·00367 for each C.; consequently warm air is lighter than cold, and moist air than dry, for the air being a *mixture* of about 4 vols. of nitrogen and one of oxygen, its density is the mean of these: $\frac{4 \times 14 + 16}{5} = 14{\cdot}4$, whereas aqueous vapour is a chemical compound, a compound gas of 2 vols. of H and one of O, condensed into two vols. $\frac{2 \times 1 + 16}{2} = 9$, *i. e.* 11·2 liters of air weigh 14·4 grains, and of water vapour only 9.

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[*] Scandalously insufficient for health.

[†] Grossly insufficient.

The quantity of water vapour that the air can hold varies with the temperature from 2 grains per cubic foot at 32° F. to 20 grains at 100° F. When it contains the utmost amount for the given temperature it is said to be saturated. Omitting fractions the capacity of a cubic foot of air at different temperatures may be thus represented. It can hold—

2 grains at	30° F.	9 grains at	74° F.
3 ,, ...	41°	10 ,, ...	77°
4 ,, ...	49°	11 ,, ...	80°
5 ,, ...	56°	12 ,, ...	83°
6 ,, ...	61°	13 ,, ...	86°
7 ,, ...	66°	14 ,, ...	88°
8 ,, ...	70°		

For hygienic purposes higher temperatures may be disregarded. Degrees of humidity mean the percentage of saturation. Thus if a cubic foot of air at 61° F. holds 6 grains of water, it is saturated ; if now it be suddenly raised to 83° F. the humidity is only 50°, since it could hold 12 grains, and if in contact with water or moist earth, &c., it will take up more vapour. But if cooled down from 61° F. to 41° it will be able to retain only 3 grains, remaining saturated, while the other 3 grains will be deposited as dew. The dew-point is the temperature at which, for any given quantity of vapour actually present, this deposit would occur, *e. g.* for 6 grains it is 61° F.

The most agreeable degree of humidity at ordinary temperatures is between 70° and 80°, though if the air be cold 50° or even 30° is not unpleasant. At high temperatures a low humidity is painful, by causing excessive evaporation from the body.

Calculation of Velocity.

The formula for calculating rate of movements of air in methods of ventilation is based on Montgolfier's law of falling bodies.

$v = \sqrt{2 f s}$, in which s = space traversed and f the initial velocity. When simply let fall $f = g$, or the attraction of the earth, *i. e.* gravitation, which gives a velocity of 32·2 feet in the first second ; then since $2\ g = 64·4$, $\sqrt{2\,g} = 8·2$, or for practical purposes 8, and the formula becomes $v = 8 \sqrt{s}$, and for fluids escaping through an aperture, s = the difference in height between the columns on either side, and in practical ventilation the height of the shaft. But we must also take into account the difference of weight of air due to expansion by different temperatures, and taking v = velocity of ascending air in feet per second, H = height of shaft in feet, t = temperature of air in shaft, t' = temperature of outer air, a = coefficient of expansion of air (·002036 for 1° F. or ·003665 for 1° C.), and $g = 32{\cdot}2$:

$$v = \sqrt{2\ g\ H\ a\ (t - t')} \text{ theoretically.}$$

But further allowance must be made for friction reducing this value of v by $\frac{1}{4}$, $\frac{1}{3}$, or $\frac{1}{2}$, for apart from that due to roughness of surface, the coefficient of friction caused by bends in smooth channels is $\frac{1}{1 + \text{Sin}^2 \theta}$ (θ being the angle made by the bend) which we call K.

If the tubes be of considerable length though straight, $\frac{1}{3}$ may be allowed for friction.

Dr. De Chaumont's Formulæ.

$$(1)\ D = I \times 200\ ,\ \frac{D}{(\sqrt{h\ (t - t') \times \cdot 002})}$$

$$(2)\ \Phi = 100\ (\sqrt{h\ (t - t') \times \cdot 002}).$$

Where D = delivery per hour in cubic feet per hour.

I = inlets and Φ = inlets and outlets in square in inches.

$\cdot 002 = \frac{1}{500}$ = nearly $\frac{1}{493}$ = the coefficient of expansion of air for 1° F. at zero or 32° F.

The different expressions for time and space require a factor 200 or 100, which is thus obtained—

$$\frac{\text{Seconds in an hour}}{\text{Square inches in a square foot}} = \frac{3600}{144} = 25, \text{ which}$$

multiplied into $\sqrt{2\ g}$ or 8 = 200 for inlets only, and consequently 100 for inlets and outlets combined.

In practice it is often better simply to multiply the area of the inlets into the velocity of the current as ascertained by an anemometer, no correction being then required for friction.

Mariotte's Law.

The volume of gases is inversely as the pressure—

$$V : V' :: P' : P \ \therefore\ V' = \frac{VP}{P'};$$

or taking density into consideration and substituting barometric height for pressure—

$$\frac{D}{D'} = \frac{V'}{V} = \frac{P}{P'} - \frac{H}{H'}; \text{ and if } H = 760 \text{ mm. (30 inch)}$$

$$D' \text{ at } H' = D \times \frac{H}{760}$$

Galton's Formula for Dilatation of Air.

Let M = its volume at standard temperature and pressure, *i. e.* at 0° C. and 760 mm.

M′ = its volume at $t°$.

a = coefficient of expansion of air by heat = ·002036 for 1° F., or ·003665 for 1° C. or for practical purposes = ·002 for 1° F.

Then $M' = M(1 + a\,t)$ for temperatures above zero, *i. e.* 32° F. and $= M(1 - a\,t)$ for those below.

The density varies directly as the temperature and inversely as the pressure—

∴ Volume at any given pressure

$$= \frac{760}{\text{pressure}} = \frac{760}{\text{height of barom.}} \times \text{its volume at 760 mm.}$$

And at any given temperature

$$\left.\begin{array}{ll} \text{if } t \text{ be in C.} & = \dfrac{273 \pm t}{273} \\ \text{or if in F.} & = \dfrac{493 \pm t}{493} \end{array}\right\} \times \begin{array}{l}\text{the volume at zero, 0° C.,} \\ \qquad \text{or 32° F.}\end{array}$$

A cubic foot of air at standard temperature and pressure weighs 566·85 grains.

A liter of hydrogen at standard temperature and pressure weighs ·08936 grams., and other gases ·08936 × their atomic weight, the product in the case of compound gases being divided by 2.

Relation of velocity and pressure of wind: V = velocity in miles per hour, P = pressure in lbs. on a square foot.

$$\text{then } P = V^2 \times {\cdot}005$$

$$V = P\sqrt{200}$$

$$P = \frac{V^2}{200}$$

The velocity of the wind in this country is seldom less than 15 or more than 35 miles an hour on land.

SOME DATA FOR HEATING AND VENTILATION.

In estimating the relative heating power of different fuels, the unit of heat is in this country usually taken as the quantity required to raise 1 lb. of water 1° F. On the continent 1 kgr. of water 1° C.

The English units of heat evolved in the complete combustion of 1 lb. of each of the following fuels are as under :—

Wood perfectly dry	7790
Peat dried artificially	9950
Coke	13550
Charcoal	17700
Coal (mean of many kinds)	14000
Petroleum	20000

Carbon burnt to carbonic oxide (CO)	4450
Carbon burnt to carbonic acid (CO^2)	14550
Hydrogen burnt to water (H^2O)	62000

Hence the great heating power of "water gas" (H and CO), with low illumination.

To calculate the quantity of air required for the combustion of any given fuel we may use the formula $12\,C + 36\left(H - \frac{O}{8}\right)$, which is based on the fact that 72 parts by weight of air represent 16 of oxygen : the weight of air theoretically necessary is therefore 12 times that of the carbon + 36 times that of the hydrogen $- \frac{9}{2}$ that of any oxygen that may be present in the fuel itself. If the unit employed be 1 lb., we may obtain the volume of air at 62° F. by multiplying the weight as given by the formula by 12·844, though practically from half as much again to twice the theoretical quantity will be found necessary. Thus 1 lb. of coal requires 300 cubic feet of air, and 1 of dry wood 160.

If the whole of the heat generated in the combustion of coal were utilized, 1 lb. would suffice to raise a room 20 feet square by 12 feet high 10° F. above the temperature of the outer air, *i. e.* making no allowance for loss by ventilation and conduction. If the air be renewed two or three times in the hour, 2 to 3 lbs. of coal per hour, or 24 to 36 lbs. for a day of twelve hours would be necessary, and in fact but little more is required with German stoves standing out in the middle of the room, where the only direct loss is through the chimney, and much even of this is given off by radiation to the air of the room along the course of the iron flue.

But English grates fixed in the wall beneath a brick chimney consume at the very least 8 lbs. per hour: allowing 300 cubic feet of air for each lb. of coal, this gives 2400 cubic feet hourly, but at the lowest computation, 4—6 cubic feet per second, *i. e.* 14,000 to 20,000 per hour pass up the chimney, and in many the loss is 10—15 cubic feet per second, or 35,000 to 40,000 per hour.

In a room containing 4,800 cubic feet of space such currents imply a renewal of the air 4, 6, or 8 times in the hour, sufficient to maintain the standard purity for from 6 to 12 persons at rest by daylight, or for from 1 person with 2 gas-lights to 6 persons with 3 ordinary burners. If the incoming air were warmed such ventilation would be agreeable, but as it is, cold and in irregularly distributed draughts, an excessive amount of fuel is consumed, and $\frac{7}{8}$ of the heat generated is lost.

The so-called "Head" or difference of pressure exerted by like columns of hot and cold air which causes the upward current in a chimney or ventilating shaft, was formerly assumed to correspond to the excess of height acquired by a given column of *cold* air when raised from t° to t′°, but is now more correctly taken as the "shrinkage" such a column of *hot* air would undergo when lowered from t′° to t° ; for, as Peclet points out, "the force of the air at the external temperature acts directly on the *cold* air which enters the chimney, and not on the hot air, and it is the velocity of the cold air that is afterwards transmitted to the hot."

The resistance offered by friction, &c., to the movement of air in pipes or other channels varies, (1) directly as the length, (2) inversely as the diameter, and (3) directly as the square of the velocity. (4) It varies with the nature of the internal surface, as this is rougher or smoother. (5) When the velocity is very low, a bend equal to right angle, which, friction apart, would reduce the rate of movement by one half, practically arrests it. With angles greater than 90°, *i. e.* with less change of direction, the loss is obtained by multiplying the original force into the square of the sine of the angle in the pipe. (6) A large and sudden change of section, as when a pipe enters a room, may be practically taken to neutralize the original pressure, and the calculation for the exit pipe must be made independently. From (5) it will be seen that whatever bends may be allowed in ventilating channels in which great differences of temperature produce high velocities, all but the most gradual change of direction should be avoided in soil pipes and others on which now powerful pressure or suction is brought to bear. In such a right angle is entirely inadmissible, and a bend of 30° from the original line of direction is the greatest that should be allowed.

Conductivity of Heat.

The units of heat transmitted per square foot per hour by a plate 1 inch thick, the two surfaces differing 1° F. in temperature, are—

Marble, gray, fine-grained	28
Marble, white, coarse-grained	22
Stone (common freestone)	13·68
Glass	6·6
Brick	4·83
Plaster	3·86
Fir planks	1·37
Brick dust	1·33
Chalk, powdered	·87

Brick is thus seen to be a far warmer building material than stone and marble, a 15-inch brick wall being equal to nearly 4 feet of ordinary building stone, and a wall of 1½ inch weather boards, ½ inch match boarding inside, and filled in with 6 inches of crushed chalk or lime, would be as warm as a brick wall three feet thick! Hence the warmth and comfort of huts for camp and hospital use. Docker's wood and felt huts, which can be taken to pieces and packed away when not required for use, are much used in the German army.

Tents are less easily ventilated than would be supposed, for though pervious to air (and rain) when dry, they become absolutely impervious when wet. In the German army tents are rendered waterproof by a dressing of india-rubber, wax, tar, and grease.

Table showing loss of heat per square foot per hour by brick and stone walls, 40 feet high, in buildings where only one face is exposed and for 1° F. difference of internal and external temperature.

Brickwork.				Stone.	
Thickness.			Units of Heat.	Thickness.	Units of Heat.
Brick.		Inches.		Inches.	
½	=	4½	·371	6	·453
1	=	9	·275	12	·379
1½	=	14	·213	18	·324
2	=	18	·182	24	·284
3	=	27	·136	30	·257
4	=	36	·108	36	·228

The loss from a low wall is greater than from a high one, since the warmed air tends to rise to the upper part, reducing the difference between internal and external temperature, *i. e.* if no allowance be made for the dispersive action of wind. Much importance is attached by most authorities to the supposed advantages presented by pervious walls as a means of ventilation, and as absorbing moisture from the air of the rooms. But the aid to ventilation is utterly insignificant, and the apparent dryness of a porous wall, as contrasted with an impervious surface on which the moisture condenses and runs down in drops, is illusory. The moisture is absorbed, and with it the organic matters of respiration and the germs of disease. Hence the sanitary advantages of paint, varnish, and impervious washable materials for interior wall surfaces. Again, damp in houses is always the result of absorption from without. It is the rain beating on and absorbed by the bricks that is drawn inwards by the higher temperature of the dwelling and evaporates, with a chilling action, from the interior face of the wall, and that which in like manner rises from the ground wherever the walls are built without damp-proof courses, and the foundations not laid with concrete.

The power of absorbing water depends on the porosity of a material, and is tested by immersing a well-dried and weighed piece in water until it ceases to gain weight. Thus treated—

Bricks—	Per cent.	Limestones—	Per cent.
Malm cutters, &c., about ...	20–22	Bath, Portland, Ancaster, &c. ...	13–17
Brown paviors ...	17	Chilmark	8
Hard, grey, and glazed paviors and stock	8–10	Kentish Rag ..	1–2
Stafford blues, &c. ...	2–6	Marble ...	a trace
Sandstones	8–10	Granite	½–2½
		Trap, basalt	a trace

Building Memoranda.

1 rod brickwork = 272 sup. feet of 13½ in. (1½ brick) wall.
,, ,, = 16½ × 16½ × 1⅛ ft. = 306 cub. ft. = 11⅓ cub. yds. = 16 tons.
,, ,, = (and with mortar) 4356 stock or 4500 place bricks.

1 foot sup. of 1½ brick wall = 16 bricks.

Bricks—stocks 8¾ × 4¼ × 2¾ inch; fire 9 × 4½ × 2¾; paviors 9 × 4½ × 1¾; and Dutch clinkers 6¼ × 3 × 1½.

500 bricks = 1 load = 28 cub. ft.

1 rod of brickwork requires 3 cub. yards = 3 loads of mortar and 160 gals. of water if lias, or 192 if grey lime be used.

Portland cement and sand are mixed as 1 : 1, 1 : 2, 1 : 3, and 1 : 4 ; about 75 bushels of the mixture being required for 1 rod brickwork, and 1 of each for 12 yards sup. of pointing.

PRACTICAL VENTILATION AND WARMING.

Ventilation may be effected independently of warming, but warming should never be attempted apart from ventilation; it is fortunately impossible to warm a room by means of fires, whether in open or in closed stoves, without at the same time obtaining some degree of ventilation, *i. e.* change of air, however insufficient; but with hot water or steam pipes ventilation must be specially provided. In the combustion of fuel the carbon combines with the oxygen of the air to form an equal volume of CO^2 under like conditions, but the CO^2 expanded by the heat evolved displaces the cold air in the chimney, and the equilibrium being thus disturbed, the unequal atmospheric pressure in the room and the chimney sets up a constant upward current in the latter, fresh air being drawn in through every aperture and crevice around doors and windows and in the floor.

The close stove, standing in the body of a room and with a considerable length of horizontal or oblique flue within the apartment, will utilize 97% of the heat produced in the combustion of the fuel, but complaints are often made of its drying and "burning" the air. The lessened relative humidity is easily obviated by the evaporation of water, but the unpleasant "scorched" smell, which is caused by the contact of organic dust with the highly-heated iron, is to be prevented only by the use, very general in Germany, of porcelain for the outer casing, a material which, unlike iron, parts with its heat too rapidly to allow of itself acquiring such a temperature as could produce the effect in question.

Closed stoves are in a high degree powerful and economical as means of heating, but utterly insufficient for ventilation. Worst of all are slow combustion stoves, as the "tortoise," in which the supply of air is so limited that the incandescent fuel being surrounded by a stagnant atmosphere of CO^2, its carbon is burnt into CO (carbon monoxide), an incomparably more poisonous gas, which escapes by the space around the lid, if not through the heated cast iron, and is also formed in the reduction of CO^2 to CO by the iron casing when red-hot. An important difference between open and close stoves is that in the former the heat given off is of the radiant kind, which warms the objects on which it impinges, walls, furniture, and persons, without directly raising the temperature of the intervening air materially. Close stoves heat the air directly, and external objects indirectly only, radiant heat not being given off in any appreciable amount.

To get the maximum of radiation from an open stove, the fire grate should stand well forward, present a wide face with oblique fire-clay checks and the narrowest possible throat to the chimney. But the so-called Galton's stoves are by far the best, since they not only fulfil these conditions, but utilize the heat, which in others is absorbed by the wall, to maintain a constant stream of warmed fresh air, combining the utmost economy of fuel with the maximum of radiant heat and ample ventilation without draughts, and this when every other aperture is closed against the entrance of cold air. The wall is built hollow, forming a chamber behind and around the stove, intersected more or less by flanges springing from the back of the grate to increase the heating surface; this chamber communicates on the one side with the open air, immediately if in an outer wall, or by a glazed pipe under the floor if in a party wall, and the air when warmed enters the room by openings on each side of and above the fire-place. A free circulation is thus kept up, the incoming air is warm, almost no heat is wasted, and if the doors, windows and floor boards be made to fit closely, draughts are entirely prevented.

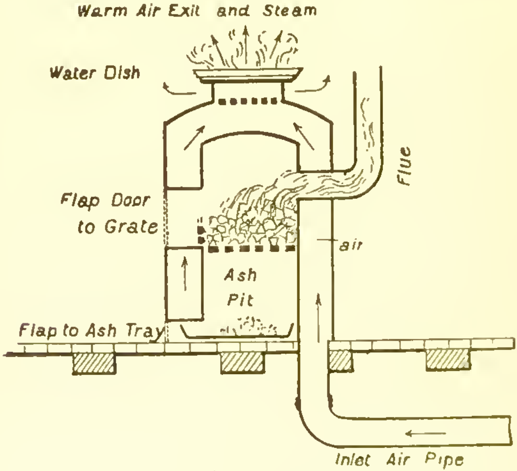

FIG. 15.

The same principle may be applied to close stoves in schoolrooms, chapels, &c., and is so generally in Canada by enclosing the stove in an outer case or jacket through which the grate is reached by a tunnel: the intervening space communicating, like the wall chamber of Galton's stoves, with the outer air through the floor and with the air of the room by a grating on its upper surface. (Fig. 15.) With Galton's open or the Canadian close stove no other inlets are really required, but if it be desired to admit cold air, Tobin's tubes are perhaps as good as any, since the apertures may be arranged sufficiently high to avoid draughts near the ground, and similar outlets distributed at the level of the ceiling. They do not, however, in practice work as well as they promise in theory.

Mackinnel's tubes are often fitted to "sunlights" in churches and public halls. The gas-burners are placed under or in the mouth of a tube rising vertically above the roof, and enclosed in another but shorter tube, of such a size that the annular section of the intervening space equals the circular section of the inner. The arrangement acts efficiently, though not sufficiently, so long as there is no disturbing factor, as in a building warmed by hot water or steam pipes, but the exhausting force of a strong fire and chimney may reverse the upward current in the inner tube and bring down the products of combustion and hot foul air into the room.

There are several contrivances for carrying away the products of the combustion of gas, with or without complete disconnection of the gas lamp from the air of the room, among which may be mentioned Ricket's, the Wenham, and the Regenerative burners of Siemens, Clarke, Thomas, and others on the same plan. Gas may, by an appropriate combination of appliances, be made not merely accessory to ventilation, but the motor power of a system adequate to the requirements of any number of persons assembled in a room or building.

A ventilating gas-burner must fulfil a number of conditions, which are thus stated by Mr. Simmance. It must be near the ceiling, without glass, and easily lighted from below. It must be shadowless, capable of being reduced until the temperature six inches above the burners shall not exceed 100° F., and of being increased until its full power effects a complete renewal of the air of the chamber every 10 minutes. The shafting must be so constructed that with a very high internal temperature the external heat shall be practically *nil*. The outlet must not be unsightly, and not only must a *blow* down, but a downward *suction* be prevented. Cowls may exclude the wind but are powerless against the effects of atmospheric pressure.

All these ends may be attained by the following arrangement. A number of Sugg's vertical flames from burners of *steatite*, which is practically imperishable, are placed beneath the mouth of an extracting shaft passing perpendicularly or horizontally from the ceiling to the open air. Mr. Dibdin has proved that the greatest illumination is afforded by the rays emitted at an angle of 45° with the perpendicular axis of the flame; those passing thus downwards illuminate the lower zone of the walls and the outer zone of the floor, and those which pass upwards at this angle are made to impinge on an enamelled iron reflector from which they are thrown down on to the middle of the floor.

The shaft is *lined* throughout with asbestos felt, absolutely incombustible and a powerful non-conductor of heat, which thus retains the maximum of heat throughout the entire length of the shaft, whether vertical or horizontal. At a suitable point communication is opened between this hot air shaft and an outer casing which opens below around the other, as in Mackinnel's tubes. But instead of being an inlet the outer channel is an additional outlet, the effect of the heated gases in passing the plane of communication being to set up by aspiration a secondary current in the outer tube, such that each cubic foot of gas burnt is capable of extracting from the combined shafts 3000 of air. Thus one to twenty burners, each consuming 5 feet of gas per hour, will withdraw 15,000 to 300,000 cubic feet of air corresponding to the complete renewal six times in the hour of the air of a room 23 ft. × 12½ ft. × 10 ft. high to a hall 100 × 25 × 20 ft. high.

To guard against down draughts the shaft should be surmounted by one of Sugg's cowls, which, consisting in an enlargement of the aperture of the shaft, closed by a horizontal plate in which are set a number of small upright tubes, and the whole surmounted by a flat cap of such an area that it is practically impossible for any wind or eddy to enter the tubes, acts as an extractor under all circumstances save an absolute calm.

But though such a shaft and cowl will ventilate more or less by the action of the wind, even when the gas is not burning, it is desirable that some automatic means should be found for moderating the suction exerted by very high winds, as well as prevent a downward suction where the exhausting action of a fire and chimney, for example, may be strong enough to overpower that exerted by the gas when burning low, or that of the wind alone when the gas is not alight. This can be secured by interposing in the cowl a horizontal plate of talc, which, threaded on a central pin only and resting on a squarely-cut seat around the shaft, is lifted by any upward pressure, but closes the channel under the slightest pressure from above.

This system of combining illumination with ventilation can be applied to new buildings with little, and to existing ones with no great, expense. It removes all the objections to gas, viz. the heat and deterioration of the air, thus presenting the advantages, from a hygienic point of view, of electric lighting without its greater cost, and has the advantage over electricity of effecting ventilation, which with electric lighting must be otherwise provided for, and avoids the danger of escapes of gas and explosions incident to all hanging and sliding gas fittings.

It is scarcely necessary to point out that this arrangement for ventilation in combination with lighting instead of with heating does not provide for the warming of the incoming air, but in the case of churches and places of public assembly this should be effected by passing the air over steam or hot-water coils, and in private houses, either in like manner or, if a system of "central heating" be deemed too costly in installation, or for any reasons undesirable, it could be effected by so constructing the air chambers of Galton's stoves as to admit of a supply sufficient for the demands of both the fire-place and the gas-lights, *i. e.* of the two outlets of the chimney and the ventilating shaft.

Cowls.

While on the subject of cowls, I may say once for all that no cowl can oppose any resistance to a downward *suction*, and no so-called "Archimedian screw" or revolving mechanism can exert any upward suction. The whole and sole function of cowls is to prevent the entrance of gusts and eddies of wind down the flue, especially those deflected at downward angles from neighbouring roofs or walls, without interfering with the aspirating action of wind passing across the mouth of the shaft at a right angle. Those which are arranged so as to present a back to the wind, with an open mouth to the leeward, fail in the latter aim, and should they also fail to move in response to every shift of the wind, will effect in an aggravated degree the evil they were intended to avert. The simpler the cowl the better; a flat plate or a conical or umbrella-shaped cap, fixed above the mouth of the shaft, answers well; but, since upward currents may be reflected downwards from the obliquity of the cap, the best form is that of a truncated cone open at the top. It is this accident that Sugg's cowl averts by substituting numerous small tubular apertures for one large opening.

Smoky Chimneys.

The conditions causing or favouring this accident are—

Internal.	External.
1. Eddies entering from above.	2. Reversal of draught by stronger suction elsewhere.
3. Excessive friction, bends, &c.	4. Exposure to cold and loss of heat.
5. Disproportionate width or shortness of flue.	6. Deficient supply of air.

The first two are intermittent, (1) varying with the direction of the wind, and (2) with the lighting of other fires, it is a frequent result of junctions between flues, (3) is exemplified in foul chimneys, (4) in those on north and exposed outer walls,

(5) in the short flues of top floor rooms, and (6) when "draughts" have been successfully excluded. It is also met with in the inner rooms of communicating suites, if no special inlets are provided.

The remedies must be adapted to the particular cause. (1) Must be obviated by a flat plate or cap cowl, the chimney being raised at the same time if necessary; (2) by separation of common flues, or by a better supply of air to an antagonistic one; (3) and (5) may be palliated by raising the chimney, or surmounting it by a tall chimney-pot, though the conditions may then be merely exchanged for those indicated under (4), which is, *e. g.* the cause of smoking in the case of naked pipe flues from stoves in out-houses, &c., and (6) can be remedied only by providing the needed quantity of air through special inlets. In the case of sets of rooms approached by a single door, the raising of one chimney, though it may cure it, will only serve to transfer the defect to another in the series.

Smoke Consumption.

No care in stoking will entirely prevent the emission at times of dense volumes of smoke from some furnaces, but the Sanitary Authority is empowered to insist on the abatement of the nuisance so far as practicable. Until the invention of his "Smoke Annihilator," by Mr. Elliott of Reading, the only process of which engineers had had any notion was to conduct the smoke back into the furnace, where the unburnt carbon underwent complete combustion. The economy of this procedure is great, for not only is the fuel utilized to the utmost, but the waste heat is added to the draught; which is constituted by hot instead of cold air. But the gases emitted from the chimney, though colourless, are none the less acrid and hurtful alike to animal and vegetable life, for the sulphur compounds escape as before in the form of sulphurous acid.

Elliott's Annihilator entirely obviates this: the smoke, prevented from passing up the chimney by a valve, is drawn through a horizontal branch-pipe by an Archimedian fan working in a drum in the pipe, and driven into a larger cylinder half full of water, with which it is churned up by a set of revolving fans of perforated metal enclosed in wire gauze; the soot is collected in a side chamber in the form of paste, the water intercepts all tarry, acid and gaseous matters, nothing but steam, air and carbonic acid escaping by the steam pipe to re-enter the chimney shaft. The soot when dried finds a ready sale for printers' ink, and other carbon preparations, the watery solution is almost identical with gas liquor, and in fact 20% of the cost of the coal may thus be recovered.

Heating apart from Ventilation.

Under this head fall the systems of heating by hot water or steam pipes, as usually carried out; but all such stand self-condemned, since they might at a comparatively trifling additional expense be made subservient to the most efficient ventilation with warmed air.

The water or steam in such pipes may be under low or high pressure, the superiority of the latter consisting in the higher temperature obtainable, and in the fact that the radiation of heat from the surface of the pipes increases with, but more rapidly than, the temperature: the boiling-point of water rising under a pressure of four atmospheres, or an additional 44 lbs. on the square inch, to 291° F. (143·8° C.), and under 10 atmospheres, or 132 lbs. of added pressure, to 375° F. (180·5° C.).

But where a resident engineer is not available low pressure boilers with air pipes for escape of steam are safer, being free from all risks of explosion. In these the circulation of the water is maintained solely by the difference of its temperature and density where it leaves and where it returns to the boiler, the velocity of the flow being dependent also on the height of the vertical column between the two, therefore when the boiler is on a level with the pipes, the shortness of the column must be compensated by a greater difference in the temperatures of the flow and return currents, *i. e.* the latter must be low, and it is never possible to reckon on a *mean* temperature of more than 160° to 180° F.

Perkins's high pressure system consists essentially of a continuous closed tube of wrought iron, one inch in diameter, about one-sixth of its length being coiled in the furnace to serve as a boiler. Above the highest level of the system is a length of pipe of much greater diameter communicating with, but not forming part of, the circuit. It is called the expansion tube or cylinder, and being filled with air which is compressible provides for the expansion of the water in the small pipes when heated. It is furnished with a screw cap. The feed-pipe connected with the lowest point in the system is carried up to the level of the bottom of the expansion tube, so that while every part of the system shall be completely filled with water, none can enter the expansion tube. The water must be repeatedly forced through the circuit to ensure the expulsion of air from every part, and the apertures in the feed and expansion tubes are then closed with screw plugs. By this system a temperature of 300° F. (138° C.) can be obtained without danger.

Under some circumstances steam under high pressure may be advantageously substituted for water, indeed it may be laid on like gas through great lengths of pipes with little loss of heat if these be encased in non-conducting materials, and a jet of superheated steam passed into a pail of cold water will raise it rapidly to boiling. In any system of heating by pipes provision should be made for warm air ventilation, and the Medical Officer of Health should strenuously oppose any scheme which does not provide for the same, and though the execution of the work will devolve on an engineer, he should be able to advise as to the particular system to be adopted.

Central Heating.

Every form of stove within a room requiring a chimney for the escape of the heated products of combustion, and a certain supply of fresh air at the same time, effects some degree of ventilation, however insufficient from a sanitary point of view in the case of the closed stove, and apt to be attended by cold draughts in that of the open fire.

Open stoves on the Galton principle, and closed ones as the Canadian, Bond's Thermohydric, George's Calorigens, &c., warm the incoming air, and are therefore self-sufficient for rooms when dealt with singly. But when the whole of a large building has to be warmed from a central source, and hot water or steam pipes are employed, means must be taken for obtaining an adequate and uninterrupted supply of fresh air, which hot pipes do not by themselves provide. This may be secured by admitting the outer air through inlet channels surrounded or traversed by coils of the heated pipes, with corresponding outlets for its escape. If the addition of an open stove for occasional use be adopted, the chimney, aided or not by ceiling outlets, will serve, though it would be much better arranged on a central system.

Common to all is the admission of the fresh air to a chamber in the basement, after filtration in towns through screens of canvas, or of cotton wool spread on wire netting, to intercept dust and "blacks"; the warming of this air by contact with the heated surface of pipes and plates, the extent exposed being under control; the regulation of its humidity by hot or cold sprays if its temperature be much raised; and its distribution to the different parts of the building.

This distribution can be effected by propulsion or by extraction, the latter method being generally preferable; and this again may be achieved by mechanical means or by the exhausting action of a powerful chimney draught, which is by far the simpler, since the other requires the introduction of a steam-engine as the motor power. Such central heating and ventilation may be seen in the Houses of Parliament, but it has been successfully and economically carried out in private houses, as those of Drs. Drysdale and Hayward in Manchester, and of Dr. Gordon Hogg at Bedford Park, near Fulham.

Great judgment is required in adjusting the dimensions of the larger shafts and smaller channels, and the temperature and velocity of the air on issuing from the heating chamber to those required in the rooms. In ventilation the velocity of the entering air should not exceed 6 or 7 feet per second in the main, and 3 or 4 in the secondary channels, and 1½ or 2 in the rooms. To obtain a temperature of 60°—65° F. in the rooms it is desirable that incoming air should be warmed to 70° or 75° F., but never above 80° F.

The only way of preventing the cold draughts so painfully familiar in winter under the ordinary plan of building is to warm the air of the halls, staircases, and passages, when it will be found that it is a matter of indifference whether the doors are open or shut. The general principles are shortly these.

The fresh air strained through canvas and warmed by hot water or steam coils in a chamber in the basement, ascends through gratings in the risers of the stairs and floors of the passages, to enter each room by inlets along the cornices. The foul air leaving by central outlets in the ceiling over gas-burners, &c., is conducted to a chamber in the roof. Cooled somewhat here, it descends by a downcast shaft to the foot of the upcast shaft, an annular chamber surrounding and warmed by the pipe flue of the kitchen fire, which is carried some feet higher than the shaft.

All these channels are fitted with valves to regulate their delivery, and the grates may be "hit and miss." In summer, when there is no need to warm the incoming air, the circulation is maintained by the exhaust action of the kitchen flue on the upcast shaft, aided after dusk by the gas-burners under the ceiling outlets, the fresh air entering as before, or through the windows if freer perflation be desired. In Dr. Hogg's house, where the windows are hermetically sealed, the rooms are found in very hot weather to be actually cooler than the outer air, while the exclusion of dust effects an enormous saving of domestic labour.

The consumption of fuel is much less than where half-a-dozen fires have to be kept up, the bedrooms are always comfortably warm, and the cost of the special construction is compensated by the additional sleeping accommodation obtainable, for there is no advantage in having "large airy" bedrooms when smaller rooms thus ventilated are never "close or stuffy."

Central heating has been developed to a high degree of perfection by German engineers, as Bechem and Post of Hanover, and Walz and Windscheid of Düsseldorf, while in Dr. Boehm's system, adopted in the principal public buildings in Vienna, hot and cold air may be mixed in any proportions, and thus laid on to any room at any desired temperature.

In central heating, as formerly carried out, air at a uniform temperature was delivered throughout the building, an arrangement open to obvious objections when different rooms are devoted to different uses. To meet these requirements fresh air is now admitted from without into each room separately, and is there warmed by passing through chambers containing steam or hot-water coils, or ribbed pipes. These "heiz-körper," as they are called in Germany, have the appearance of handsome stoves or cabinets, through the ornamental open work in the fronts and sides of which the warm fresh air enters, the fouled air escaping by flues heated by the pipes in their passage from floor to floor.

By means of additional coils, and by duplicating the pipes, by the regulation of the cold air inlets, and by disconnecting any of the coils from the general circulation by stop-valves, the temperature in any room may be varied and controlled at pleasure, while the central furnace and boiler may be utilized for working a dynamo, and heating, ventilation, and electric lighting be combined in one system, together with steam power for pumping or other purposes.

Haag's steam-water stoves consist of two concentric cylinders, the inner of which forms the shaft for the admission of fresh air, while the intervening space is nearly filled with water heated by a steam coil, controlled by a regulating stop-valve.

The following tables, taken chiefly from Mr. Anderson's papers in the Proc. Inst. C. E., will serve to show the relations between temperature and emission or heating power.

Anderson's estimate of 1 sq. foot of heating surface for 65 cub. feet of space to be warmed if a room, or 24 cub. feet if a greenhouse, makes no allowance for renewal of the air, but Mr. Boulton, treating of the use of exhaust steam for the purpose of heating, calculates one superficial foot of steam pipe for every six super. feet of glass in windows, one for every 120 super. feet of wall, ceiling, &c., one for every six cub. feet of air removed for ventilation per minute, and 15 % on the total to provide for emergencies. The steam of one horse-power may generally be made, he holds, to suffice for 30,000 cub. feet.

Excess of temperature of the radiant over that of the recipient in degrees F.	Temperature of recipient of radiant heat in degrees Fahrenheit.			
	32°	50°	104°	212°
	Ratio of heat emitted in units.			
18°	·997	1·075	1·355	2·150
108°	1·212	1·307	1·648	2·615
324°	2·07	2·23	2·81	4·46

Mr. Anderson, experimenting on hot-water pipes at low temperatures, *i. e.* 50° F. above that of the surrounding air, found the units of heat given off from each square foot to be—

Temperature of air	32°	39°	46°	53°	60°
Temperature of pipes ...	28°	89°	96°	103°	110°
Heat units given off per sq. foot	68·87	69·89	72·01	70·94	73·13

Another table is copied from Mr. C. Hood's latest treatise on warming, and will doubtless be found of service to those interested:

	Ft. run of 4-inch pipe to every 1,000 cubic feet.	Will give a temperature of	Remarks.
Public Rooms	5	55° F.	In cold weather.
Dwelling Houses	12	65°	
,, ,,	14	70°	
Halls, Shops, &c.	10	55°	
,, ,,	12	60°	
Workrooms, &c.	6	50° to 55°	
,, ,,	8	60°	
Schools, &c.	7	55° to 58°	
Linen, &c., Drying Rooms	150 to 180	120°	When empty.
Linen, &c., Drying Rooms	150 to 180	80°	When full of wet linen.
Bacon, &c., Drying Rooms	20	70°	
Greenhouses	35	56°	In coldest weather.
Graperies & Storch's	45	65° to 70°	
Graperies & Storch's	50	70° to 75°	
Pineries, Hothouses, and Cucumber Pits	55	80°	

Peclet's formula for calculating the heat given off by radiation, and that communicated by contact to the air and distributed by convection, when reduced to British units, F.°, and barometer in inches, becomes $u = m \times 1{\cdot}00427^{\theta} \ (1{\cdot}00427^{t} - 1) + 0{\cdot}2853 \times t \ 1{\cdot}233$, where

u = *total* units of heat emitted by radiation and convection.
θ = temperature of surrounding air.
t = difference of temperature between air and pipes.
p = barometric height, and m = the coefficient of radiation for the metal of which the pipe is made,

Mr. Anderson makes $m = 122$ for cast iron and 250 for wrought iron pipes.

An iron flue heated to 1250° F., *i. e.* to a dull red, will give off $90^\circ/_\circ$ of radiant and $10^\circ/_\circ$ of heat of convection, whereas one at 140° F. will part with its heat equally to walls and air.

Mr. Anderson gives the following diagram (Fig. 16), showing at once the total units of heat given out by cast and by wrought iron pipes, whether carrying hot water or steam, calculated per square foot and per hour, for various differences of temperature between the heating surface and the air. In this reduced figure the ordinates are drawn at intervals of 10 degrees, and the abscissæ of 50 units; but in an enlarged form for practical use the division might be extended so far as desired.

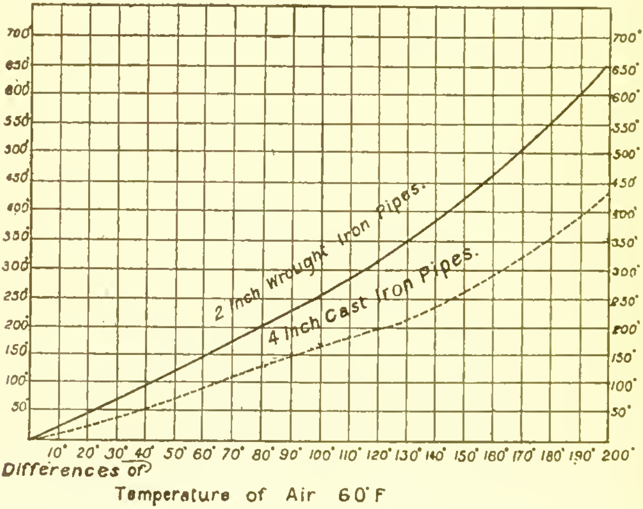

FIG. 16.

NOTE ON GAS IN HOUSES.

Two innovations since the first appearance of this work have been the practice of largely diluting coal gas with the so-called water gas, or H, containing very large percentages of the deadly monoxide CO, which, being nearly odourless, greatly increases the danger of accidental escapes; and the introduction of acetylene CH_2, produced by the action of water on calcium carbide Ca_2C, as an illuminant, rivalling the electric light in brilliancy and whiteness, and specially suited to country houses, the manufacture requiring no skilled or hard labour.

Ventilation of Schools, Churches, and Places of Public Assembly.

The ventilation of all buildings which are for a certain number of hours densely packed is necessarily difficult, but there is no longer any excuse for the extreme and positively dangerous pollution of the air so often met with in churches, courts of justice, schools, and theatres. For the last named mechanical methods, or true central heating, is applicable; courts and schools are best dealt with in the combined system (p. 182); but the conditions of churches are peculiarly difficult. The high roofs, gables, clerestories, &c., do not, as might be supposed, facilitate the escape of the foul air, for, chilled on reaching the roof, it descends to be re-breathed by the congregation, especially if insufficient provision is made for the admission of warmed fresh air from below. In the Memorial Church of Berlin, which resembles St. Paul's in plan and proportions, though one-third smaller, Prof. Fischer has overcome this tendency by arranging series of steam-coils in increasing numbers up to the summit of the dome, so that the temperature rising from the floor to the roof, the warm fresh air, admitted at 18 feet from the ground level, after falling on the congregation and being breathed, ascends to the exits in the lantern in a constant upward stream. The high temperature maintained in the dome prevents the circulation of the foul air, while the general arrangements are such as to permit of a temperature of 60° F. being maintained throughout the service and in all weathers, the incoming air being cooled in summer.

For temporary hospital or camp-huts the army plan of double boarded walls, weather boards on the outer, and match-boarding on the inner side, the latter stopping short six inches or thereabouts from the top, and the outer leaving a like space below, except that the lowest board, instead of being left out altogether, is slanted outwards so as to throw off the rain. This arrangement provides ample inlet with the least possible draught; the outlet is constituted by what is called in Germany a "riding roof," as in Fig. 17, showing the boarding without standards, joists, or beams. It is equally suitable for any building, as workshops, cowsheds, &c., where an ample supply and renewal of air, without much draught, is a greater consideration than its temperature.

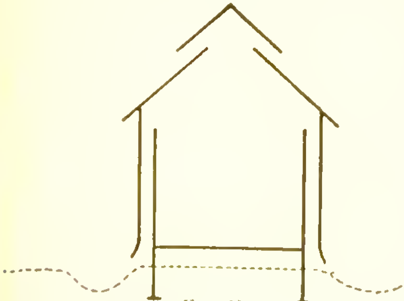

Fig. 17.

Mechanical Ventilation.

In factories and workshops, where steam power is always available, the removal of dust or vapours is best effected by Blackman's ventilators, archimedian screws, two to four feet in diameter, by about one in depth, revolving with great rapidity, which may be fixed in the walls or ceiling. The aerophores of Treutler and Schwartz of Berlin, enclosed in cylinders, may be arranged so as to act in either direction, some extracting the foul and others introducing fresh air, warmed or moistened if desired.

Mechanical ventilation is ill adapted to the circumstances of buildings, public or private, which are sub-divided into stories and rooms, with passages and stairs, producing lines of strong draught and dead spaces of stagnant air, and of churches with high and draughty roofs, but would be very effective in withdrawing the hot foul air from the galleries and under the ceilings of theatres.

Compressed Air.

Liquid air holds out prospects of enormous possibilities in the future, but in the mere liberation of compressed air we have a means of ventilation combined with cooling that no mechanical arrangements can approach.

The following table shows approximately the cold produced by expansion and heat produced by compression of air, the vol. at 60° F. and at pressure at sea-level being taken as 1·0 :—

Atmospheres.	Inches of mercury.	Volume of the air.	Actual temperature of the air in F. during the process.	Difference F. due to compression or expansion.
0·50	15	1·634	− 36°	− 96°
0·83	25	1·137	+ 33°	− 27°
1·00	30	1·000	+ 60°	0°
1·25	37·5	0·85	+ 94°	+ 34°
1·50	45	0·75	+ 124°	+ 64°
2·00	60	0·61	+ 175°	+ 115°

If air be first compressed, and after being cooled down to the normal temperature be allowed suddenly to expand, the cold produced will be equal to the difference between the temperature caused by the compression and the normal temperature. This process, already employed for the transport of meat from New Zealand, &c., might advantageously be used for the cooling of crowded public buildings in hot weather.

Natural Illumination.

Much attention has been directed, though with incommensurate results, to the sanitary aspects of artificial lighting, but the problems of natural illumination have hitherto been wholly ignored by architects, the sole attempt to ascertain the laws by which the characters and direction of the light in schools, lecture-rooms, workshops, &c. should be determined having been made by Dr. Förster of Breslau; and the following extracts from a paper I read at the Society of Medical Officers of Health contain the only statement in English of Förster's investigations, which I have there somewhat extended.

"It is almost superfluous to observe that the admission of direct sunshine into a room is annoying, if not actually painful. A south aspect is consequently to be deprecated, unless there are windows on the north wall also, when the former may be of ground or tinted glass. Provided the window space be ample, and the light be not shut out by neighbouring buildings, a north aspect is most agreeable.

"The most perfect ease in reading, or in fine work, is felt in the open air on a summer day when the sky is overcast. Under these circumstances the light is ample, but it is perfectly diffused, there is neither glare nor shadow, and the light may be said to come from all sides, but from no one in particular.

"Much has been written in condemnation of cross lighting, as if it were in some way specially injurious, but the objections thereto are groundless, since nothing can be better than a clear *shadowless* uniform light, assuming of course that the direct rays of the sun are excluded. Thus roof lighting where practicable is the very best, but failing this, opposite windows facing east and west are to be recommended, since in rooms so arranged there is no direct sunlight for a great part of the year. Should circumstances permit, windows may be made in the north wall also, since, barring sunshine, there can never be too much light. But the light must come *direct from the sky*, and no part of a room may be deemed sufficiently lighted from which a certain extent of sky cannot be seen. In the country this is easily attained, but in towns the houses on the opposite side of the street render such illumination difficult. In the accompanying figure (Fig. 18, p. 188), which represents a building of several stories, forming part of a street, the opposite houses of which are of the same height, it will be seen that each room is divided into two regions of different degrees of illumination, by a plane *a c*, formed by a line drawn from the ridge of the roofs of the opposite buildings and the upper border of the windows. Below this plane the light is sufficient, or at any rate is 'sky-light'; above it is insufficient, and obtained by diffusion only. In the upper floors this plane strikes the farther walls; in these the whole of the occupied part of the room is in the light, but in the lower stories it falls on the floor and a greater or less part of the floor space, and desks will be in relative darkness, and unfit for reading, writing, or needlework.

"But this is not all: the intensity of the light depends on two factors, the angle of incidence, and what, borrowing an optical term, we may call the angle of aperture, meaning thereby the arc of sky visible at any given point in the room. This is shown in the figure by the lines *fe*, *eg*, and it will be seen that this angle, greatest in the uppermost floor, diminishes as we proceed downwards, until on the ground floor it vanishes altogether. Dr. Förster, of Breslau, lays it down that the angle of aperture should on no account be less than 5° in any part of the room. The effect of increased obliquity of the incident rays in reducing the intensity of the illumination is shown in (Fig. 19, p. 189), which represents a number of equal pencils of light, *a*, *b*, *c*, *d*, *e*, each containing 10° of arc, proceeding from one luminous point *o*, and therefore under like conditions of equal illuminating power; but when falling on a horizontal surface, covering sections increasing as they depart more and more from the perpendicular; the intensity of the light in the several sections will then be inversely as the squares of their widths,

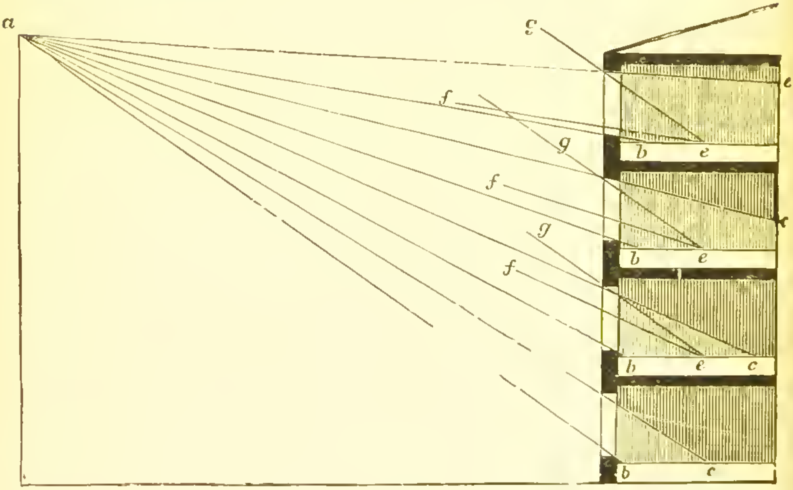

FIG. 18.

representing the tangents of the respective angles, and in the sections fg, ik, and kl, as 1^2, $(\frac{1}{2})^2$ and $(\frac{2}{7})^2 = 1$, $\frac{1}{4}$ and $\frac{1}{12}$. Förster has come to the empirical conclusion that under no circumstances should the angle formed by the upper border of the pencil with the floor be less than 25°.

"In houses forming part of a street the angular aperture is, as we have seen, greater in the upper stories, and in the lower the requisite amplitude is to be sought by increasing the height of the rooms, by carrying the window heads nearly to the level of the ceiling, the sills being five or six feet above the floor, and by avoiding the proximity of other buildings on the side from which the light is derived. The evils resulting from a too great inclination of the rays of light are to be avoided in like manner, but more effectually, by reducing so far as possible the relative width of the rooms, which should on no account be greater than 2½ times the height of the window heads from the floor. This ratio gives an angle of 25° to the rays reaching the floor on the further side; but it would be well if the width of the room did not exceed twice its height.

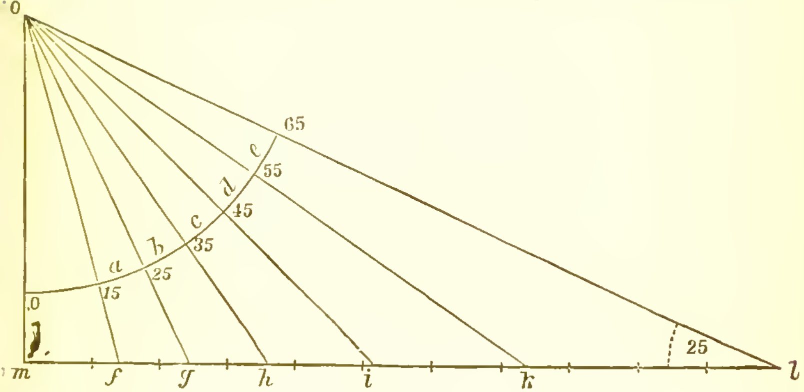

FIG. 19.

"A strong argument in favour of cross lighting from east and west on right and left hand of the scholars is, that the angles formed by the rays of light with the floor are thereby doubled, and the intensity of the light increased fourfold; while, if the windows are placed laterally as regards the scholars, and direct sun-light excluded so far as possible, the objections urged against such cross lighting are, we believe, purely imaginary.

"In all cases white ceilings reflect additional light, while tinted walls are grateful to the eyes of the workers. Black boards and maps should never be placed between windows, but, if fixed, on the opposite dead wall."

VI. POTABLE WATERS.

Absolutely pure water does not exist, and waters hygienically pure have special characters according to their sources.

Rain-water is distilled water + matters dissolved in its passage through the air + others taken up in the course of collection. It is characterized by the very small amount of suspended or dissolved solids, very low chlorine, unless from sea spray or manufactories, sulphates near towns only, but ammonia in proportions often equal to those present in rivers and spring waters.

Upland waters from granite, slate, or rocky collecting grounds, and those from lakes in mountainous districts, are practically rain-water, containing only a little more vegetable matter.

Deep spring waters contain little ammonia or suspended inorganic matter, but the dissolved mineral matters vary enormously with the nature of the beds through which the water has percolated. In the chalk and limestone $CaCo^3$ is most abundant, but in the lias sulphates and chlorides may be present in such proportions as to render the water undrinkable except as a medicine.

Shallow well waters are very uncertain ; usually chlorides, nitrates, and ammonia, free and albumenoid, indicate organic contamination. The most impure shallow wells are often held in high repute on account of the "sparkling" character of their water, which is in fact highly aerated with the carbonic acid gas evolved in the decomposition of the organic matter in the soil. Such are the wells near graveyards and in towns.

The course or direction of the ground water is of infinitely more importance than the actual distance of a source of pollution. A well twenty yards from a cess-pit, if up the ground stream, may be safer than one a hundred or more below it. Indeed, in porous soils and in fissured rocks, pollutions may be carried to indefinite distances.

River waters vary much : those of upland streams near their sources resemble the spring-waters of the locality ; lower down suspended solids appear, and in populous countries more or less abundant evidence of sewage pollution, to which in manufacturing districts is added that due to factory wastes. River waters differ considerably during drought, flood, &c.

During flood the suspended matters are at the maximum and the water is consequently turbid, but the dilution reduces all other impurities to the minimum.

During drought suspended matters are at the minimum owing to subsidence, but all dissolved matters are at the maximum, the inorganic through concentration, the organic through decomposition of the deposits.

Filtration of Public Water Supplies.

The efficiency of well-made sand filter-beds in removing not only the suspended but the dissolved organic impurities and bacteria, is very remarkable, and their action not generally understood. Sand in itself presents only the coarsest of mechanical filters, but so long as the flow of the water through it does not exceed four inches per hour, the suspended particles are attracted by the grains of sand and adhere to their surfaces. The process is in no sense filtration, but rather a "multiple subsidence," for if the movement of the water be accelerated they are lifted and pass through, rendering the filtrate more or less turbid.

The reduction in the dissolved impurities and in the bacteria is effected by the green felt-like film of living algæ that forms rapidly under the influence of air, light, and warmth, arresting the bacteria, fostering the nitrifying organisms, and assimilating the dissolved organic matter as pabulum.

It should not be removed until so thick as to seriously impede the flow, and when "cleaning" has been necessary, the "filtered" water should not be served out before the film has formed again, and the bacteria do not number more than 80 to the cub. c.m., a rule strictly observed in Berlin and most German towns. Filter-beds should be freely exposed to air and light, though the tanks for storing the filtered water may with advantage be covered, especially in towns.

Domestic and Portable Filters.

Turbid waters, and those containing putrid matter, parasites, worms, or an excess of salts, are repulsive to the senses, but the danger of such as are clear and palatable depends on the presence of the bacteria of disease, and filters incapable of removing these are obviously useless, while in many the filtering material serves as a hot-bed for the multiplication of the microbes. Dr. Plagge, in conducting a course of careful bacteriological experiments in the laboratory of the Imperial Board of Health at Berlin, found (1) sand filters utterly worthless, (2) carbon filters entirely inoperative, enteric and cholera bacilli passing freely into the filtrate. In one provided with a double process of filtration through blocks of specially prepared carbon, the water used contained when drawn from the town mains 68 bacteria to the cub. cent., but after filtration 12,000. (3) The results obtained with Bischoff's spongy iron were disappointing. The bacteria in unfiltered river water were reduced from 38,000 to 24,000 or 18,000, but not lower. (4) "Paper," *i. e.* compressed cellulose filters, were better, but not satisfactory even when frequently sterilized. (5) The only filters capable of yielding an absolutely germ-free filtrate were those constructed on Pasteur's principle; but the Berkefeld of kieselguhr, Dr. Hesse's of asbestos, and some others, required too frequent cleaning and sterilizing to be relied on for general use. The Pasteur-Chamberland, of fine porous porcelain, as perfected by Messrs. Defries of Houndsditch, cannot be surpassed; and by the ingenious arrangement of series of double-chambered drums, each containing 50 or more "bougies" or cylinders, this firm has overcome the objections on the score of slowness, and turns out installations capable of supplying any quantity to 150,000 gallons per diem, or more if it were desired.

Water Analysis.

Indications of high value.

Suspended solids.
Dissolved solids.
Total, temporary, and permanent hardness.
Chlorine.
Nitrates (as HNO^3).
Ammonia.
Albumenoid ammonia.
Oxygen absorbed.

Indications of secondary value.

Fixed and volatile, *i.e.* inorganic and organic.
Loss on ignition.
Alkalinity (in terms of H^2SO^4 neutralized).
Nitrites.
Sulphates (as H^2SO^4).
Any metals as iron, lime, &c., in solution.

The practice of stating results in grains per gallon (*i.e.* parts per 70,000) presents no advantages, is unscientific, and renders comparison with reports of other and foreign analysts difficult. It is much to be desired that all analyses were stated in parts per million, *i. e.* in milligrams per liter, when if parts per 100,000 be preferred, the change involves merely moving the decimal point.

The statements are, however, easily convertible by a simple multiplication. Thus—

(1) Grains per gallon × 14·3 will give parts per million or milligr. per liter.

(2) Parts per million × 0·07 will give grains per gallon.

(1) The former operation will be rendered easier by the help of the following table, which may soon be learned by heart.

1 = 143   3 = 429   5 = 715   7 = 1001   9 = 1287
2 = 286   4 = 572   6 = 858   8 = 1144

(2) The latter requires merely the multiplication table of 7. In the former 1, in the second 2 decimal places to be marked off in the product.

Chemical Indications.

Total Solids have little if any significance in themselves as regards pollution, depending on the solubility of the rocks through or over which the water flows: they are lowest in upland surface waters, and highest in those from deep wells. Surface and river waters during flood are always highly charged with solids in suspension. The inverse ratio between these and the dissolved solids is well seen in the analyses of the Irwell in flood and in drought.

Chlorine.—The absolute quantity teaches little. A water like the Droitwich springs may be undrinkable, yet free from organic pollution. The normal local standard of Cl. in waters known to be unpolluted should be ascertained, when a marked excess over this, with a corresponding excess of ammonia, affords a presumption of sewage pollution, which should be verified by inspection of the surroundings. The chalk beneath the London clay is highly saline, though beyond possibility of pollution, and some deep waters in the coal measures contain 50 pts. per 100,000!

Free ammonia, as a rule, is in direct proportion to organic—*i.e.* sewage—pollution, and is accompanied by a corresponding excess of organic ammonia and chlorides. In pure upland surface waters it ranges from *nil* to ·002 parts per 100,000, or after floods to ·004, and in well waters should not exceed ·005. But in deep wells and springs it may be present alone, without organic pollution, in large amounts, arising from the reduction of nitrates by the action of iron (in the rocks, or of that of the tubes used in boring, and left in position).

Organic (*albumenoid*) *ammonia* is always the product of organic matter, and in wells should never exceed ·003 to ·005 parts per 100,000, though in upland surface waters ·008 to ·01, unaccompanied by an excess of Cl., may be present from the decay of vegetable matter if the water be imperfectly filtered. But if combined with an excess of Cl., or more than ·005 of free ammonia or ·5 of N. as nitrates, it affords positive evidence of sewage.

Nitrates and *nitrites* are often spoken of as indicating "previous sewage contamination," but the expression, though literally accurate, is misleading, for nitrates being the ultimate product of the "mineralization" of organic matter, are evidence of the self-purification of the water, and *pro tanto* of the harmlessness of the organic matter which, as in the deep chalk waters, may be of geological age (and the New River Company's water contains more when drawn wholly from such wells than when mixed with that from the River Lea), while they may be entirely absent from crude sewage in which the process of purification has not even begun. In upland surface waters any appreciable amount indicates the presence of manure from cultivated land, and if as much as ·03 be found, the water should be subjected to filtration. In well waters ·4 or ·5, if unaccompanied by organic ammonia and other evidence of sewage, need not be deemed a defect.

Nitrites may be formed in the reduction of nitrates referred to under free ammonia; but generally in river and surface waters, and in shallow wells, or in deep wells exposed to contamination, they, as the earlier and transitional stage in the nitrification of organic matter, are properly considered to indicate the recent or present character of the pollution.

The *oxygen absorbed* being obviously in direct ratio to the oxidizable matters present, and these being mostly organic and usually of animal origin, is an indication of equal significance with the organic ammonia. They may, however, if accompanied by a low proportion of nitrates and of chlorine be, under easily recognizable circumstances, the result of the presence of vegetable débris.

Temporary hardness is no objection to a potable water, though a high degree renders it unsuitable for laundry purposes, and leads to crusting of boilers.

Acidity, alkalinity, and except in the case of dolomitic, liassic, and a few other waters, the *permanent hardness* are the effects of pollution with factory wastes.

Lead, unless in the vicinity of mines, is due to the solvent action on the service pipes and leaden cisterns of vegetable acids present in peaty waters, as those of the Yorkshire moors.

CHEMICAL PROCEDURE.

[For test and standard solutions, &c., required, see p. 199*b*.]

Total solids.—Evaporate 100 ccs of the water in weighed platinum dish over water-bath and weigh.

Solids in suspension.—Collect on weighed filter, dry over water-bath, weigh and examine chemically and microscopically.

Solids in solution.—Proceed with filtrate as for total solids.

Loss on ignition.—By heating dish containing total solids over Bunsen burner till a white ash only remains, and weighing.

Hardness, total.—If total solids were less than 20 per 100,000, take 50 cc, but if between 20 and 50 take 25 cc, and if over 50 take 10 cc, in these cases making up to 50 cc with distilled water. Pour it into a 6-oz. stoppered bottle, and run in the soap sol. from a burette 1 cc at a time, shaking the bottle after each addition, until the lather lasts for some minutes, then by 0·1 cc only until the lather does not break after five minutes. If 25 cc were used multiply number of cc of soap sol. by two, and if 10 cc by five, and calculate hardness by table.

Permanent hardness.—Boil 100 ccs in porcelain dish for fifteen minutes, pour into 100 cc bottle, add distilled water to make up loss by evaporation, and test 50 ccs with the soap solution as above.

Temporary hardness is ascertained by subtracting the permanent from the total.

Chlorine.—[If the water, as when polluted by factory wastes, be acid or alkaline, neutralize by Na_2CO^3, or HNO^3. If very foul with putrefying sewage, add sol. of pot. permang. till it remains green on heating; acidulate with dilute HNO^3, heat to near boiling, filter and neutralize.] Measure 100 ccs into porcelain dish, and add two drops of pot. chrom. sol. to give a pale yellow colour, charge burette to 0 mark with standard sol. of $AgNO^3$, and run it in 1 cc at a time at first, but later 0·1 cc only, stirring with glass rod until a faint red of silver chromate ceases to disappear. The number of ccs of the silver sol. used before the red colour persists indicates milligr. of Cl. in 100 ccs, *i.e.* parts in 100,000. It is well to repeat the operation on the other 50 ccs.

Ammonia, free and organic (albumenoid).—Wash out the apparatus, first cleansing the retort with a little weak HCl., and to avoid breaking it wipe the outside dry, never let the Bunsen flame touch the glass above the level of the water, and turn it down when the water is low. If the water be acid, neutralize with Na_2CO^3. Measure 500 ccs. of the water into the retort, and distil 100 ccs into Nessler tube I, and then into tube II. Drop into II 2 ccs of Nessler's solution; if no colour appear the whole of the free ammonia is in I, but if it react distil 50 cc into another tube, testing it in like manner till no reaction is obtained, putting each 50 ccs back into the flask, and setting the two tubes aside.

Organic (albumenoid) ammonia.—To the water remaining in the retort add 50 ccs of alkaline permang. sol., and collect the distillate, 100 ccs in Nessler tube III, and 50 ccs in IV. Test the latter and proceed as before.

Since as a rule the whole of the free ammonia passes over with the first 200 ccs, and of the organic with the first 150 ccs following the introduction of the permang., it is usual to estimate the ammonia in these only, ignoring the traces yielded later, though the free ammonia must be entirely expelled before the reduction of the organic matter is begun.

The determination of the ammonia in each tube is made separately. To each add two ccs of Nessler's test, and note the colour after two minutes. For comparison fill up another graduated tube to 100 ccs with ammonia free water, 2 ccs of Nessler, and so many ccs of the standard ammon. sol. as appear likely to give the same shade of colour when the tubes standing on a white slab or paper are viewed from above. If the shades be identical the observation is complete, but if that of the standard be the darker the solution must be pipetted off until the lessened depth correspond with the colour of the water; thus, if 5 ccs of the standard were too much, and the required shade appears when the volume has been reduced from 100 ccs to 80 ccs, the standard indicated is $\frac{80}{100} \times 5 = 4$ ccs of the sol. If, however, the water examined give the darker hue, the procedure must be reversed, thus we might have $\frac{100}{80} \times 5 = 6{\cdot}25$ ccs, or tube I may be mixed with II, and the determination made for both at once. To calculate the ammonia, free or organic, add the number of ccs of standard sol. required by each tube, this gives the amount in hundredths of milligr. in the 500 ccs, and × 2 in 1000 ccs, and lastly, × 100 in parts per 100,000, the usual statement.

In analyzing sewage effluents, &c., 25 ccs should be diluted with 450 ccs of ammonia free water; the free ammonia collected in a 500 cc flask, and the organic in the 100 cc Nessler tubes, but further diluted if necessary.

Nitrogen as nitrates.—Measure into two similar beakers 10 ccs of the water, and 10 ccs of the KNO^3 sol. Evaporate just to dryness over water bath, when cool drop into each 1 cc of phenol sulphuric acid, replace on water bath for 10 minutes, then wash out each repeatedly into a Nessler tube to 50 or 60 ccs. Add 25 ccs of liq. potassæ to each, and fill up to 100 ccs. The action of the nitrates on the pheno-sulph. acid in presence of KHO is to form potass. picrate, the intensity of the colour depending on the amount of nitrates. Each cc of the standard = 1 per 100,000 of N as nitrates. Draw off from the darker tube until the colours correspond, and compare depths of columns. If the water were darker the N is over 1 per 100,000; if the standard sol., then it is under that amount.

Nitrites.—A qualitative test is usually deemed sufficient. Add 5 drops of the KI sol. and 5 of the starch sol. to 25 ccs of the water in a test tube; mix well, and add 10 ccs of dilute H_2SO^4, when if any appreciable amount of nitrites be present, the blue colour of iodine and starch will appear. A control experiment on pure distilled or nitrite free water is advisable. A quantitative determination may, however, be made by Griess' colorimetric method.

To 100 ccs of the water in a glass cylinder add first 1 cc of the sulphuric acid, and then 1 cc of the metaphenylene diamine solution. If the red colour appear at once, repeat with a diluted sample, so that the reaction shall not occur until after a few minutes. To two similar cylinders, one containing the water under examination, diluted if necessary, and the other pure distilled water, add equal quantities of the test solutions, and to the latter the standard solution drop by drop from a burette, comparing the colours in each exactly as in Nesslerizing. But since the colour rapidly deepens the observations must be begun and made simultaneously.

Oxygen absorbed.—Unfortunately analysts have not agreed on the temperature at which the process should be conducted or its duration, though the results depend greatly on these conditions. Most adopt 80° F. for four hours, but 80° C. would be better on every ground.

Two 12-oz. stoppered bottles are to be cleansed with strong H^2SO^4 and rinsed. Into one 250 ccs of the water to be examined, and into the other the same of fresh-boiled distilled water are poured; to each 10 ccs of dilute H_2SO_4 and then 10 ccs of the permang. sol. are added, and they are kept at the temperature adopted for the number of hours preferred; but so often as the permang. in the water examined fades, further additions of 10 ccs of the standard are added. When the time has elapsed 2 ccs of the KI sol. are added, turning the pink to yellow, then the thiosulphate sol. is run in from a burette till the yellow becomes a faint straw colour; next 1 cc of starch sol., which gives a deep blue; and lastly, thiosulphate is added slowly till the blue disappears.

The procedure is then gone through with the control bottle, in which, if the water be absolutely pure, the permang. remains unchanged. Note the ccs of thiosulphate sol. used in each case; that in the control bottle corresponding to 10 ccs of permang. sol., *i.e.* to 1 milligr. of oxygen; and if we call these x and y respectively, the oxygen consumed by the oxidizable matter will be $1 - \frac{y}{x}$ milligr., or if a second 10 ccs of permang. sol. have been required, $2 - \frac{y}{x}$ milligr., and since only 250 ccs of water were operated on, this result × 4 gives the milligr. in 1000 ccs, or part in 100,000, of oxygen consumed.

With sewage and effluents 50 ccs only should be taken, diluted with 200 ccs of pure water, and the results multiplied by 20 instead of 4.

Lead.—Waters sufficiently acid to give a red colour with methyl orange at the reservoir, will act on the lead of the pipes. To estimate it, fill two Nessler tubes with 100 ccs of the water suspected, and of pure or distilled water respectively. If the former be discoloured by peat, add burnt sugar to the latter to match the tint; to the former add a few drops of acetic acid and 1 cc of $(NH_4)^2S$ sol., stirring well and noting the brown or blackish colour caused by the lead. Then add 1 cc of the am.

sulph. to the pure water, and drop into it from a 5 cc pipette the standard lead sol., stirring it all the time, until the colour is identical with that of the water in question. Each cc of the sol. containing one-tenth milligr. (·0001 grm.) of lead, the number of ccs required by the 100 ccs of water represents parts per 100,000 of lead, anything over ·05 being positively dangerous if habitually drunk.

Alkalinity.—In ordinarily pure waters this is practically the same as the temporary hardness, *i. e.* is due to calcium carbonate. When it exceeds it the alkali is either soda or ammonia; the former from factory waste, the latter from the same, gas liquor or sewage. To 250 ccs of the water add 5 ccs of normal sulphuric acid, boil down to 100 ccs; titrate back with normal caustic soda, added to distilled water in a similar vessel as in Nesslerizing, using methyl orange as an indicator. The H^2SO^4 neutralized by the alkalinity of the water itself, less the temporary hardness, represents the additional or foreign alkali present. For practical purposes the equivalents of H^2SO^4 [98] and of $CaCO^3$ [100] may be considered identical.

The estimation of phosphates, sulphates, magnesia, &c., is rarely required in sanitary practice, and volumetric and colorimetric methods not being available, it should be referred to a professional expert in analysis.

Water Types.

For reasons explained under *Chemical Indications*, it is obvious that there can be no single standard of constitution universally applicable, but since the Health Officer may desire, and the public expect, some means of comparison between the water in question and the best or usual examples *of its kind*, I give on the following page a number of analyses, all recent, and some, as those marked *official*, of the very latest date. I have selected them with great care, so as to include representatives of every class of potable water, surface or deep, and though personally preferring and strongly recommending the use of the world-wide metric or decimal notations, I have, for the convenience of those who may need such a table most, rendered all the reports into grains per gallon.

	Rain-water from roof, Univ. Coll., London.	Upland Surface Waters			Spring Waters	
		Lake Bala, Wales.	Peaty Moorland, Scotland.	Source of Irwell, Lancs.	Mountain	Rock, red Sandste.
					Acqua Marcia, Rome.	Guy's Cliff.
Total Solids ...	2·0	1·95	7·50	4·50	20·73	35·00
Hardness	0·50	0·28	3·50	4·60 (?)	19·25	?
Chlorine	0·15	0·706	0·50	1·05	2·75	3·08
Nitrates (HNO^3)	0·01	None	0·01	0·03	0·01134	0·21
Nitrites	None	None	None	None	None	None
Ammonia	0·0005	0·0007	0·0015	0·016	Organic C; 0·0098 N; 0·0021	0·004
Album. Am. ...	0·0005	0·0010	0·0185	0·013		0·007
Ox. absorbed in 2 hrs. at 80°F°	0·005	?	0·150	?	0·0024	0·031
Authority ...	Kenwood	Wanklyn	Kenwood	Davis	Cannizzaro	Stokes

	Metropolitan Water Companies					R. Kennet, Thatcham (unfiltered).
	West Middlesex.	Lambeth.	East London.	New River.	Kent Co.	
	Thames (filtered).		River Lea (filtered) and Chalk Wells.		Chalk Wells.	
Total Solids ...	18·55	19·95	23·00	22·00	27·00	24·50
Hardness	12·95	14·2	15·00	16·00	19·00	?
Chlorine	1·26	1·33	1·50	1·30	1·50	1·12
Nitrates (HNO^3)	0·133	0·147	0·16	0·16	0·32	0·339
Nitrites	None	None	None	None	None	None
Ammonia	None	None	0·0010	0·0005	0·0005	0·0014
Album. Am. ...	0·0056	0·0056	0·0040	0·0025	0·0020	0·0112
Ox absorbed in 2 hrs. at 80° F°	0·042	0·0434	0·028	0·015	0·0120	0·074
Authority ...	From Official Analyses.					Stokes

	Deep Wells			Surface Wells		
	Silurian.	Oolite.	Chalk.	Present Pollution.	Remote Pollution.	Good Water, *near sea*, Yarmouth, I. of Wight.
	Anglesea.	Elton, nr. Peterborough.	Debden, Saffron Walden.			
Total Solids ...	17·00	70·00	44·10	35·50	32·00	50·40
Hardness	?	?	?	20·50	19·50	27·00
Chlorine	8·54	2·38	5·83	6·50	6·50	10·08
Nitrates (HNO^3)	0·07	None	1·13	0·70	1·70	0·108
Nitrites	Traces	None	Traces	None	Traces	None
Ammonia	0·004	None	0·0084	0·015	0·002	0·0014
Album. Am. ...	0·011	0·007	0·0042	0·018	0·003	0·0070
Ox. absorbed in 2 hrs. at 80° F°	0·07	0·031	0·030	0·150	0·038	0·0250
Authority ...	Stokes	Stokes	Stokes	Kenwood	Kenwood	Stokes

Fauna and Flora of Potable Waters.

In lakes and reservoirs many kinds of aquatic animals and plants are useful, if not indispensable, for maintaining the normal purity of the water. Water-fowl, fish, crustacea, and flowering plants co-operate in the economy of nature: eels and cray-fish, carrion feeders, being invaluable as scavengers.

Biological Examination.

The significance of the lower forms of animal and vegetable life is various. Even those that flourish in polluted waters are active agents in the so-called "self-purification" of rivers, especially the entomostraca, which subsist solely on dead animal matter, not so far decomposed as to be fit for the food of plants. Some, annelids and protozoa, as *anguillula* and *paramœcium*, indeed, indicate gross pollution; but others, as the *daphne*, *cyclops*, and *hydra*, are found only in clear running streams, though of course they should not occur in filtered water. Among plants the *chara* and *lemna* render the water offensive and unwholesome.

But no report on a water supply is complete or satisfactory without a bacteriological examination; for quantities of fæcal matter too minute to make any perceptible addition to the albumenoid ammonia, or the chlorine, may, if derived from a case of enteric fever or of cholera, suffice to spread the disease. Numerous outbreaks have followed the use of water pronounced by chemical examination only to be of high purity and perfectly safe, but in which the *Bacillus coli* was present in abundance, and communications found with drains or cesspits.

The physical conditions of the soil and site, and the surroundings, should always be inquired into on the spot, and red aniline dye poured down neighbouring closets, drains, &c.

Still, no examination whatever can do more than pronounce on the water at the moment when it was taken.

Bacteriological Examination of Water.

Since examinations by any but *trained* bacteriologists are worse than useless, I shall not describe procedures, and manipulations, or precautions, assuming a knowledge of these; but absolute uniformity in every detail being necessary for valid comparisons, I shall give directions for making the best media, &c. The water should be collected in 1 oz. bottles, with overhanging stoppers, and conveyed to the laboratory in a small box within another filled with crushed ice.

The medium. One pound of finely-chopped *lean* beef in 1 litre of *distilled* water slowly heated to 60° C. in water-bath, kept at that temperature for 10 minutes, and quickly raised to

100° C. ; then filtered and made up with distilled water to 1 litre. Ten grams of *Witte's* peptone and 5 grams of common salt are carefully worked up with the broth, a little at a time, then 100 grams of *best French* gelatine are added, and the mixture poured into a flask, which is kept in a steam sterilizer until the solution of the gelatine is complete, to aid which the flask should be taken out and well shaken every 10 minutes. It is next neutralized by $\frac{N}{1}$ NaOH, using litmus paper as an indicator. Then cooled to 50° or 55° C., the white of an egg added, well shaken, and returned to the sterilizer for half-an-hour, filtered through *Papier Chardin*, and 10 ccs poured into sterile test tubes, plugged with cotton-wool, and placed in the steam sterilizer for 20 minutes. The sterilization is repeated on the two succeeding days, the tubes being kept meanwhile in the ice-box. To melt the gelatine the tubes are stood in a water-bath at 40° C. for 10 minutes, and to each some of the water is added, and mixed by swinging, not shaking, and their contents poured into Petri dishes standing on ice, the lids being lifted no higher than is necessary. With a 1 cc pipette graduated to tenths the gelatine plates are inoculated with 0·2, 0·3, and 0·5 ccs, if the water be presumably good ; if suspected to contain 200—1000 bacteria per cc, six plates are inoculated in pairs ; and if bad the water is to be diluted 1·0 cc to 9·0 ccs of sterilized water, and the inoculations, six at least, made as before. Foul waters may well be diluted 100, and such as sewage effluents even 1000 times, for if the colonies be crowded the stronger prevent the growth of the weaker. The plates must be incubated at 20° C. for three days, and the colonies enumerated. Many bacteria require higher temperatures, but the results of the procedure as described above are practically the best for comparisons.

Moulds apparently indicate badly constructed wells, and are frequently found in surface, subsoil, upland, and river waters, but rarely in deep wells. They may be recognized among other colonies by their hyphœ, but flourish best in beer-wort gelatine. Pathogenic and parasitic microbes (e. g. *B. Coli*, *Typh.*, and *Enterit.*) find their optimum at 37° C., the temperature of the living body, but will grow at 42° C., which few others can.

The number of bacteria in a safe water being, like its chemical composition, very fairly constant, and the ratio between the pathogenic (if any be present) and the indifferent being so too, any great increase, not clearly due to high temperature, may be taken as evidence of sewage contamination, dangerous in proportion to the number of colonies, and thus indicated before chemical analysis can give any help. The *B. Coli* will then be found, and where it is, those of enteric fever may have access too. If the *B. Coli* be detected in several samples of 20 ccs or less, the water should be at once condemned; if in quantities between 20 and 50 ccs, and 50 and 100 ccs, it is more or less dangerous; if several hundred ccs are required it is probably, and when litres, absolutely safe.

For practical purposes, as those of the M.O.H., the search for the typhoid bacillus is almost a waste of time, and his failure might be misinterpreted. The demonstration of *B. Coli* is conclusive of sewage pollution, and its isolation is not very difficult. But a special medium, anaërobic conditions and high temperature are required to ensure success.

The medium. Kitasato's glucose formate broth is prepared by adding to the meat infusion 1% of peptone, 2% of glucose, 0·5% of salt, 0·4% of sodium formate, and after boiling and neutralizing, 2 ccs of $\frac{N}{1}$ NaOH to the litre. The broth is again boiled, filtered, and put up in test tubes, which are sterilized by boiling for 20 minutes, then and on the two following days. *Anaërobic conditions* are best obtained by means of Buchner's tubes, in which are placed the tubes of broth after inoculation with the water, and incubated at 42° C. for 24 hours, when those showing growths are removed; this is done for two more days, after which any still sterile may be thrown away. From these gelatine (and if wished agar) plate cultures are made in the usual way, and incubated at 20° C., any suspicious colonies being from time to time sub-cultivated and worked out. As large quantities of water are required the contents of a Winchester quart are to be forced under pressure * through a Pasteur's filter bougie, which is afterwards washed out with 10 ccs of sterilized water. The bacteria of 2000 ccs are thus collected in 10 ccs, a concentration of 200 in 1, and 0·1 cc. of this represents 20 ccs of the original water.

N.B.—It must be borne in mind and emphasized in reports that where *B. Coli* is, the *B. typh.* may be; that where *B. typh.* is, the *B. Coli* will be in enormously greater numbers, and that they tend by secretion or otherwise to quickly destroy any *B. typh.* among them, so that the absence of the latter proves nothing.

P.S.—For further directions as to the examination of water, milk, &c., for pathogenic and excremental bacteria, see a paper by Mr. Walter Pakes in *Public Health*, vol. xii., p. 325, to which I am indebted for the greater part of this section.

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* The best apparatus is one made by Messrs. Baird & Tatlock, of Cross Street, Hatton Garden, for Mr. Pakes.

Standard Solutions and Reagents.

Soap solution.—Castile soap 10 grms. ; Alcohol 1 liter.

To be standardized by the

Calcium chloride solution, 1·11 grms. to the liter, each cc containing Ca = 0·001 gram (1 milligram) of $CaCO^3$.

Normal caustic soda and *normal sulphuric acid solutions*, each cc = 0·049 grms. of H^2SO^4.

Standard silver nitrate solutions containing 4·75 grms. to the liter, each cc = 0·001 chlorine.

Decinormal solution of pot. permanganate, 3·18 grms. to the liter standardized by

Decinormal oxalic acid solution 6·3 grms. to liter, each cc = 0·0008 grms. (0·08 mg.) oxygen.

Alkaline permanganate solution pot. permang. 8 grms., caustic potash 200 grams, water (free from ammonia) 1 liter.

Standard ammonium chloride solution of 0·0315 grms. to liter, each cc = 0·01 mg. NH^3.

Standard iron solution (stock sol.). Dissolve 1 grm. pure iron wire in H^2SO^4 diluted with nine parts of water and made up to 1 liter. Ten ccs made up to 1 liter for use, each cc = ·01 mg. of iron.

Pure anhydrous sodium carbonate must be always tested for the presence of ammonia, and *caustic soda* can only be had free from nitrates by being freshly prepared from the metal.

Nessler's solution.—Pot. Iod. 35 grms., mercuric chloride 13 grms., water (free from ammonia) 700 ccs. Dissolve, heat to nearly boiling, then drop in some more cold saturated solution of $HgCl^2$ till the red ppt. is just permanent, then add 160 grms. of caustic potash or 120 of caustic soda. Dilute to 1 liter, and finally add a few drops of the mercuric chloride solution to render it sensitive.

Standard Soap Solution.—A strong sol. of the Sapo mollis of the Br. Pharm. in equal volumes of alcohol and water is filtered, and diluted with alcohol until 2·2 cc are required to give a lather persisting for five minutes when shaken with 50 cc of a solution of $Ba(NO^3)^2$ of 0·26 grams to the litre of water. [A stock solution of 2·6 gr. in a litre is diluted with nine parts of water when wanted for use.]

VII. DIETETICS.

PRINCIPLES OF DIETETICS.

Albumen containing nitrogen is essential for the repair of the tissues. The products of its metabolism, urea and uric acid, are excreted by the kidneys. As fuel, *i. e.* for the production of heat and energy, it is very inferior to the non-nitrogenous food stuffs, fats and carbohydrates, which being resolved into CO^2 and water only do not add to the waste materials in the blood, or tax the kidneys for their elimination : the allowance of albumen should not, therefore, to any great extent, exceed the needs of the tissues, and will be the same for the same individual under all circumstances, except during rapid growth or recovery from emaciation. If the supply of fats and carbohydrates be ample, any excess of albumen breaks up into urea and fat, of which it is the source. The carbohydrates do not, as it is commonly thought, produce fat, but presenting a more convenient fuel, permit the excess of albumen to be used for making fat, instead of being used up as fuel.

Fats and carbohydrates, being oxidized or metabolized into CO^2 and water, are the best fuels, and the amount given should be regulated by the amount of energy or work demanded. Tissue waste is very much less than is commonly believed, and is not appreciably increased by work. Muscular exercise leads to a great increase in the elimination of CO^2 and H^2O, with corresponding consumption of oxygen, and calls for a like increase in the *non*-nitrogenous food stuffs. A certain proportion of the excess of albumen is retained in the fluids of the body as the "circulating albumen" ; a further excess leads to the deposition of fat, and beyond this to the accumulation of uric acid in the blood, gout, gravel, &c., unless metabolized by great exertion in the open air, with limitation of the non-nitrogenized food stuffs and a vigorous digestion.

Proportion and Amount of the several Food Stuffs required.

A normal diet for an average man taking moderate but healthy exercise would be albumen 5 oz., fat 3 oz., and carbohydrates 15 oz. Persons following sedentary occupations would find albumen 4 oz., fat 2 oz., and carbohydrates 12 oz. enough, but those engaged in laborious work may require as much as albumen 6-7 oz., fat 4-5 oz., and carbohydrates 16-18 oz. Elderly people in warm rooms will do with as little as albumen 2½ oz., fat 1½ oz., and carbohydrates 9 oz. Albumen is the sole source of nitrogen, but the fats and carbohydrates, though both are necessary for perfect health, are to some extent interchangeable, and the relative proportions depend on the tastes and habits of the individual, except that fats are more efficient than carbohydrates where hard work is performed under exposure to extreme cold. The dependence of the quantity of nitrogen required on the physique of the individual, and of the carbon on the amount of muscular exercise, as well as the preference shown by some men for fatty and by others for starchy foods, irrespective of their social position or employment, is clearly seen in the analyses by J. Förster of the diets of several men in the University, all robust, perfectly healthy, and having entire freedom of choice, containing in grams—

	Alb.	Fat.	Carbo-hydrates.	N.	C.
Young Medical man, A.	127	89	362	20	297
,, ,, ,, B.	134	102	292	21	280
Porter, aged 38 years ...	133	95	422	21	321
Carpenter	131	68	494	20	342
Beadle, powerful old man	116	68	345	18	295

Calculation of Dietaries.

Let x, y, z be the several articles of food. Construct a series of simultaneous equations representing on the one side the percentages of albumen, of fat, and of carbohydrates in each respectively, and the quantity of the food stuff required on the other, and solve in the usual manner.

Ex.—How much oatmeal and milk will be required to constitute a diet containing alb. 5 oz., fat 3 oz., and carbo-hydrates 15 oz., as nearly as possible?

The percentage composition of these is—

	Water.	Alb.	Fat.	Carbohyd.	Salts.
Oatmeal	19	12	6	60	3
Milk	87·3	4	3	5	0·7

The water is ignored, since the food stuffs are calculated dry or water free.

(1) $\frac{12x + 4y}{100} = 5$ oz. (the standard of albumen).

(2) $\frac{6x + 3y}{100} = 3$ oz. (the standard of fat).

(3) $\frac{60\,x + 5\,y}{100} = 15$ oz. (the standard of carbo-hydrates).

Solving these equations we find that—

x, i. e. the oatmeal = 20 oz. = 1¼ lbs.
y, i. e. the milk = 60 oz. = 3 pts.

To find the salts—

Oatmeal contains 3% × 20 = 0·60
Milk contains 0·7% × 60 = 0·42
1·02

The total salts are 1 oz.

In the same way a more varied diet can be arranged to fulfil the same requirements, estimating the composition of the several constituents as follows—

	Albumen.	Fat.	Carbohydrates.	
Cooked meat	35	7·5	—	Per cent.
Bread	8	—	50	
Potatoes	—	—	22·5	
Cheese (poor)	30	10	—	
Bacon	10	70	—	
Butter	—	80	—	
Oatmeal	12·5	5	65	
Milk	4	3	4·5	
Beer	—	—	5	

The following rations of each would give—

	Albumen.	Fat.	Carbohydrates.	
½ lb. = 8 oz. Cooked meat	2·8	0·6	—	Ounces.
1½ lb. = 24 oz. Bread	1·9	—	12·0	
½ lb. = 8 oz. Potatoes	—	—	1·8	
2 oz. Cheese	0·6	0·2	—	
2 oz. Bacon	0·2	1·4	—	
1 oz. Butter	—	0·8	—	
½ pint = 10 oz. Milk	0·4	0·3	0·4	
1 pint = 20 oz. Beer	—	—	1·0	
	5·9	3·3	15·2	

A liberal diet for a working man.

Analysis of Various Foods, after König and others.

	Water	Alb.	Fat	Carbo-hydr.	Salts	
Beef, prime joints	72	21	6		1	König
,, as supplied to army	75	15	8·5		1·5	Parkes
Beef, prize fat beasts	63·5	14	19		1·5	Lawes & Gilbert
,, salt	49	29	1		21	Girardin
Veal, lean	78	19	1·5		1·5	König
,, fat	72	19	7·5		1·5	,,
Mutton, good ...	76	18	5		1	,,
,, very fat ...	48	15	36		1	,,
Pork, fat	47·5	16	34		2·5	,,
,, ,, ...	39	10	49		2	Letheby
,, salt	44	26	8		22	Girardin
Bacon	15	9	73		3	Letheby
Ham, fat	48·5	16	34·5		1	König
,, lean	69	21	8		2	,,
Poultry	74	21	4		1	Letheby
,, fattened ...	70	10·5	9		1·5	König
Goose	38	16	45·5		·5	,,
Eel	57·5	12·5	28·5		1·5	,,
Salmon	76	15	7		2	,,
Herring, fresh ...	80	10	8		2	,,
Sole	86	12	·5		1·5	,,
Milk, average ...	86·9	4·7	3·5	4·2	·7	Blyth
,, country ...	87·7	4·	3·	4·6	·7	Wanklyn
,, town ...	86	5	4	4·3	·7	,,
,, Devon fore ...	90·35	4·20	1·15	3·50	·7	Blyth
,, Guernsey fore	88·40	5·15	·35	5·20	·9	,,
:. Devon strippings	83·95	5·27	5·8	4·08	·9	,,
,, Guern. strippings	83·4	4·3	5·95	5·45	·9	,,
,, Cond., sweet., mean	25·6	12·3	11·	16·3	2·4	32·4 Pollens
,, ,, ,, maxima	35·66	20·14	18·78	18·35	3·87	40·48
,, ,, ,, minima	12·43	7·79	7·54	10·82	1·56	24·11
,, unsweetened, max.	53	26	20	18	2·3	
,, ,, min.	46	13	13	12·5		
Cream, raw ..	60·75	3·45	32·80	2·45	·55	Bell
,, Devonshire	33·75	5	59·80	1·0	·45	,,
Cheese, Stilton ...	23	32	40	1	4	,,
,, rich ...	36	28	30	2	4	,,
,, medium ...	46	28	20	3	3	,,
,, poor ...	48	32	9	7	4	,,
,, Dutch ...	41	28	23	1	7	,,
Butter, English, fresh	12	2	85		1	,,
,, ,, ,, best	8	1	90		1	,,

Analysis of Various Foods, after König and others (continued).

	Water	Alb.	Fat	Carbo-hydr.	Salts	
Butter, lightly salted	13	1	83		3	Bell
,, highly salted	17	1	74		8	,,
Wheaten Flour, fine	16·5	13	1·5	68·3	·7	
,, household	11·8	16·2	1	70·3	·7	Wanklyn
,, best do.	12·7	12	1	72	·7	Bell
,, best white	13·5	12	1·2	72·5	·8	,,
Oatmeal, Scotch ...	15	13	6	63	3	Letheby
,, groats ...	10	14·3	5·7	68	2	König
Maize	14	10	7	66·5	2·5	Pozziali
,, ...	10·6	14	3·8	70·7	·9	König
Rice	10	5	·1	84·4	·5	Parkes
,, flour	14	7·4	1	77	·5	König
Bread, best wheaten	34	9·5		54·5	2·	Wanklyn
,, average ...	40	8	1·5	49	1·5	Parkes
Biscuits, Army & Navy	8	15·6	1·3	73·4	1·7	,,
Peas, dry	15·6	22	2	58	2·4	,,
Beans, field ...	14·8	23·7	1·6	56·7	3·2	,,
Lentils	12·5	24·8	1·8	58·4	2·5	,,
Potatoes	74	1·5	·2	23·3	1	,,
,, ...	75·8	1·8	·1	21·3	1	König
Cabbage, white ...	91	2	2	5·5	1·5	
,, winter ...	80	4	1	13·5	1·5	
,, Brussels sprouts	85·5	5	·5	7·8	1·2	
Carrots	87·8	1	·2	10	1	König
Turnips	91	1	·2	6·8	1	,,
Parsnips	82·5	1·3	·7	14·5	1	Parkes
Beet-root	87	1·5		10·5	1	König
Onions	88	1·7	·1	11·5	·7	,,

Proportions Utilized and Wasted.

The foregoing tables, showing the proximate composition of all the chief articles of food, do not give a true notion of their nutritive qualities, unless one knows what proportion of their several constituents is utilized in the organism, and what passes away unabsorbed, with the fæces, and is therefore lost. This has been ascertained for a few of the most important and typical forms of food, by Prof. Gruber, of Gratz who gives as the means—

	Total dry substances	Albumin.	Fat.	Carbo-hydrates.
	In one hundred parts of each there remain unabsorbed—			
ANIMAL FOODS—				
Lean meat	4·7	2·5		
Eggs	5·2	2·9	5·0	
Milk	8·1	6·75	5·2	
Cheeses	6·4	3·3	5·2	
Fats	8	...	12·7	
VEGETABLE FOODS—				
Maize	6·7	15·5	17·5	3·2
Pease	14·5	27·8	...	7·0
White wheaten bread	4·65	18·18	5·7	1·2
Brown ditto ...	12·2	30·5	...	7·4
Black or rye bread	15·0	32·0	...	10·9
Rice	4·1	20·4	7·1	·9
Potatoes	9·4	32·2	3·7	7·6
Carrots	20·7	39·0	6·4	18·2
Cabbages	14·9	18·5	6·1	15·4

Wines, Beers, and Spirits.

The presence of more or less alcohol is common to all, but there is also a certain dietetic value in the maltose of beers and the glucose of wines, though in the so-called "dry" wines this is reduced to a minimum, while in stout it is artificially increased by the addition of treacle, burnt sugar, liquorice, &c. ; the vegetable acids, tartaric in wine, acetic in beer, and malic in cider, have also a dietetic though not a nutritive value. The ferment in wines, including cider, is derived from spores floating in the air, in beers it is the yeast fungus. "Cognac" is, or should be, distilled from wine, but most brandy is, like whisky, made from malt, and rum from molasses, *i. e.* sugar spoilt in the boiling by being converted into the uncrystallizable form. Gin is simply potato or malt spirit flavoured with oil of juniper.

Natural Wines.	Alcohol.	Free Acid.	Sugar.	Colouring with Tannin Extracts, &c.
Red wines (means):				
Rhine	10·08	0·52		0·16
Hungarian (Carlowitz)	9·65	0·59		0·13
Burgundy	11·15	0·53		?
Bordeaux	9·07	0·59		0·22
White wines (means):				
Rhine	11·45	0·46		
Moselle	12·06	0·61		
Riesling	12·90	0·65		
Hungarian Tokay (sweet)	12·74	0·52	14·99	18·34
Fortified wines:				
"White" Port, 1860	20·03	0·54	4·88	8·83
Red Port, 1865 ...	21·91	0·45	6·42	8·83
Sherry, 1870, "dry"	22·90	0·44	1·88	3·78
Madeira, 1870 ...	19·11	0·48	3·46	5·22
Marsala, 1872 ...	20·44	0·39	3·48	4·94
Malaga, 1872 (sweet)	16·14	0·42	16·47	21·23
Sparkling wines:				
Champagne	11·75	0·58	11·53	13·96
Sparkling Rhine wine	12·14	0·57	8·49	12·14

At the English custom houses the alcoholic strength is estimated as "proof spirit," and since this means spirits consisting of alcohol 49·24 and water 50·76 per cent., the figures following, if halved, will represent the true alcoholic strength as given in the preceding table :—

Natural Wines.

Burgundies ...	21·5	Rhenish	21·9
Clarets ...	17·75	Hungarian lighter	21·8
Beaujolais ...	20·8	,, stronger	24·0

	Natural state.	Slightly fortified.	Fortified for English Markets.
Sherries	27·2	30·7	35·7
Ports	23·5	33·6	34·4
But as sold in the shops, many Ports, Sherries, &c. contain			38–45

Since the presence of 14% of alcohol in a saccharine solution arrests further fermentation, this is the absolute limit to the alcoholic strength of a natural wine. It is approached in Tokay, Riesling, and some Moselles, as well as in natural sherries. Anything beyond this is added by way of "fortifying" the wine.

Sugar is added to the fortified Spanish wines and Champagnes, but some of the Greek wines are naturally so rich in sugar as to be positively syrupy. The taste is no accurate test of the free acid or of the sugar present, since these may mask one another. Dr. Dupré found in natural and fortified wines the following amounts in grains per bottle.

	Sugar.	Free acid.
Bordeaux	11·4 to 18·4	65·7 to 77·4
Rhine Wines	0·0 ,, 8·6	57·6 ,, 70·3
Ports	121·2 ,, 519·7	49·5 ,, 62·1
Sherries	217·2 ,, 421·2	55·3 ,, 61·1

Beers.

	Water.	CO^2.	Alcohol.	Albmn.	Malt Extract.	Ash.
English mean	88·52	0·21	5·16	0·73	6·32	0·27
Porter, Barclay & Perkins ...	88·44	0·16	5·4		6·0	
Burton Ale ...	79·6	0·?	5·9		14·5	
Edinburgh Ale	80·45	0·15	8·5		10·9	
Berlin Ale ...	85·93	0·17	7·6		6·3	
Munich Bock Bier	86·49	0·27	4·2		9·2	
,, Lager Bier (16 mo. old)	89·75	0·25	5·2	0·49	5·0	
Munich draught Ale	90·26	0·24	3·8	0·81	5·8	

"*Fusel Oil.*"

When alcohol is obtained directly from sugar, as in wine, cognac, and rum, it is exclusively ethylic, but when indirectly by the transformation of starch into sugar, there is always more or less of amylic alcohol, which is far more injurious, and which, together with other by-products, goes by the name of "fusel oil." This is always present more or less in spirits made from grain or potatoes, though when good malt only is used, in which the whole of the starch has been converted into maltose, a form of sugar, the amount of these by-products is comparatively very small. But in the manufacture of all but the very best whiskeys much raw grain is added to the malt for cheapness, and the product contains a large proportion of fusel oil, which, however, in all cases tends to diminish in course of time by the reduction of some of its constituents into less injurious bodies. Hence the advantage of keeping whiskey for several years in the vat. Blending is the artful mixing of different qualities to please the palate.

The presence of amylic alcohol in rum is evidence of adulteration with potato spirit.

The colours of whiskey, brandy, and rum are due to conventional additions of burnt sugar.

Preserved Foods.

New Zealand mutton as now imported is not strictly speaking frozen, no ice being used: it is kept at a temperature of a few degrees above freezing point by means of the expansion in the chamber of previously compressed air. It is placed in the refrigerating chamber before *rigor mortis* has set in, and is on its removal in precisely the same condition as if just killed, except that it is drier and therefore less inclined to speedy decomposition, and as regards soundness or the reverse is to be looked on in the same light as fresh home bred meat.

Canned foods are heated to boiling point and hermetically sealed. They may become putrid if air gain access through a defect or breach of the soldering. Tinned salmon, tongues, &c., occasionally acquire intensely poisonous characters, probably through the formation of ptomaïnes; such, however, usually appear somewhat altered, drier and more friable, or deficient in jelly.

Imperfectly sterilized condensed milk evolves gases, when the tins bulge. Fraudulent dealers puncture such "blown" tins, soldering up the punctures.

"Green" bacon, *i. e.* bacon very slightly cured, has frequently been known to give rise to serious gastro-intestinal disturbance amounting to poisoning.

Boric and salicylic acids are much used for keeping fresh and preserved foods, meat juices, extracts, and peptonized preparations, from putrefaction. Fresh fish are certainly kept sweet and free from flies by watering them with a solution of boric acid, and this may be deemed legitimate, but there is reason to believe that boric acid tends rather to conceal than to entirely prevent change, and its use as a preservative of milk, cream, butter, &c., should be discouraged if not entirely condemned.

VIII. SCAVENGING.

Scavenging, or the collection, disposal, and, when practicable, the utilization of the various kinds of refuse ceaselessly accumulating in the midst of crowded populations, devolves, except in two or three towns, on the Engineer, as the officer presiding over the streets, though consisting in the removal of nuisances, and being itself apt to create nuisances of another kind, a fact recognized in the Public Health (London) Act, which places it among the Offensive Trades.

It is one of the most urgent of the duties entrusted to the Sanitary Authority, the difficulties of which increase year by year with the growth of towns in area and population.

It is far less a question of engineering than are the water supply and sewerage, and the Medical Officer of Health cannot but be frequently called on to protest against dangers to health or to advise as to their removal, while there are few departments in which there is so great need for the introduction of new and more rational procedures.

The matters to be dealt with are—

1. Street refuse, commonly or technically known as "slop."
2. House refuse, called "dust."
3. Market refuse, including also that from slaughter-houses, and from butchers', fishmongers', fruiterers', and greengrocers' shops, costers' stalls, &c.
4. Stable-dung and manure from the streets.
5. Trade refuse, excluding that from markets, &c.

To which is added in some towns human excreta from privies, pails, and middens, and in all, at some times, snow.

Several of these, indeed, have a greater or less value as manure, and in small towns find a ready market among the neighbouring farmers, but in proportion as the cultivated land recedes, the cost of carriage increases until no profit remains, and their destruction becomes the better economy. So too with "dust," the breeze and ashes are eagerly taken by builders when extensive brickmaking or building is going on in the immediate vicinity of their origin, but later the production exceeds the demand, and the cost of carriage more than covers any profit that might accrue from the sale, even if the demand did not at the same time fall off.

Some L.A.s are in the habit of mixing refuse of considerable manurial value with other of an inorganic and inert character, with the aim of saving labour, and of rendering the latter saleable in virtue of the admixture of the former; but it is probable that it would be more profitable to keep them distinct, the proceeds of the one covering the loss on the disposal of the other. Thus, stable manure and the horse-droppings collected fresh by boys in temporary receptacles in the streets will always fetch a fair price among market- and other gardeners, for whose purposes the more bulky, coarser, and fouler mixtures are ill adapted.

STREET REFUSE.

Composition.

The dust of the streets in dry, and the mud in wet, weather consists essentially of the *débris* of the stone metal or paving, abraded iron, and pulverized horse-dung, in varying proportions. The moisture ranges between 35 $^{\circ}/_{\circ}$ in the driest to 90 $^{\circ}/_{\circ}$ in the wettest weather, ordinary mud yielding about 50 $^{\circ}/_{\circ}$ of water when desiccated. The dry solids, then, average 55 to 60 $^{\circ}/_{\circ}$ of horse-dung, 30 to 35 $^{\circ}/_{\circ}$ of powdered stone, and 10 to 15 $^{\circ}/_{\circ}$ of abraded iron. The following table, giving the results of the late Dr. Letheby's numerous analyses of mud and manure under different circumstances, though five-and-twenty years old, is still useful as a standard of comparison.

Composition of Mud from Stone-paved Streets, Horse-droppings, and Farmyard Manure, dried at 300° F.

Constituents.	Fresh Horse-droppings.	Farm-yard Dung.	Mud from Stone-paved Streets.		
			Maximum Organic (Dry Weather).	Minimum Organic (Wet Weather).	Average.
	per cent.	per cent.	per cent.	per cent.	per cent.
Organic ...	82·7	69·9	58·2	20·5	47·2
Mineral ...	17·3	30·1	41·8	79·5	52·8
	100·0	100·0	100·0	100·0	100·0

It will be seen that the enormous reduction of the organic, or more strictly the increase of the mineral, matter in wet weather is real, and not a relative change or result of an excess of water. More mineral mud is formed, for it is a product not so much of the wearing away of the face of the stones, as of the working upwards through the interstices between the stones of the finer particles, which the saturation facilitates. Hence the importance of a good concrete foundation for paving, the freedom of the impervious asphalt from mud beyond what is carried from elsewhere, and the utter unfitness of "macadam" for constant and heavy traffic. Hence too the large percentage of organic, *i. e.* the small proportion of mineral matter in the mud collected from wood or asphalt paving, though the absolute quantity may be reduced to a minimum on these smooth surfaces by the prompt removal of all horse-droppings as they fall.

Quantity of Mud.

There is every reason to believe that the proceeds of unadulterated horse-droppings would pay for the cost of immediate collection in all busy thoroughfares; the great question is that of the disposal of the inorganic mud. The bulk of this depends on the nature of the paving, and the mode and frequency of the sweeping. Full 50 % of the substance of a macadamized road consists of fine dust or mud, and not 10 % of stones over an inch in diameter; indeed, it is probable that, as Mr. Burt, who began his career as a road-maker under MacAdam himself, estimates, a third of the metal laid down is crushed to a useless powder before the road has set.

It is a fact that the oftener the streets are swept the less the *total* mud created and removed, while the expense is little if at all increased, and the road is kept in better condition. When the macadamized streets in Manchester were first swept three times a week with a Whitworth machine, the mud produced was found to be only one-fifth of that removed when they were hand-swept twice in three weeks, and in Birmingham a saving was effected of one-third in the materials required for repair. The cost of machine-sweeping is less and the cleansing more complete, 50 % more being collected from any surface than could have been by hand.

On granite cube-paved roads the detritus forms, on the contrary, but a small portion of the mud. The quantity of mud collected from granite-paved streets in Manchester is found to average not more than $\frac{1}{7}$ to $\frac{1}{5}$ of that from a like area of macadam, and Col. Haywood calculated that the loss of the granite cubes on London Bridge would not account for $\frac{1}{30}$ of the dry solids gathered as mud.

In London generally, outside of the City, where the traffic is great, but the horse-droppings are not instantly removed, the dry sweepings from granite- or wood-paved streets contain no less than 75 % of horse-dung, while it may not exceed 5 % of that from macadamized roads. The actual quantities vary greatly in different places: in the London districts, for example, from 60 to 660 cub. yards per mile, and in certain quarters and streets much more; the absolute maximum being on London Bridge, at the rate of 8000 cub. yards per mile in the year! A proportion, by no means inconsiderable, of matters properly of the nature of house and even of trade refuse is carelessly or wilfully added by the householders to the refuse to be collected from the streets.

It is a pity that the L.A.s have not availed themselves of the clause in the Metr. Man. Act, 1855, empowering them to appoint and pay proper persons as regular crossing-sweepers at suitable points.

House Refuse, or Dust.

This, collected at regular intervals from the dustbins of private houses, consists primarily (1) of ashes and more or less coarsely-sifted cinders; (2) matters legitimately committed to the dustbin, as broken glass and crockery, old metal of all kinds, empty tins, &c.; (3) others that though inoffensive would be better burnt, as wood, corks, old baskets, cardboard, paper, and string, with rags of every description; and (4) bones and animal and vegetable matters, moist, putrefying, and offensive—"nuisances, injurious or dangerous to health."

The quantity varies considerably both absolutely and in the proportion it bears to the refuse of the streets and sewers. The quantity of mud depends very much on the material of the roads, but under like conditions the ratio of dust to slop is highest in quiet residential and lowest in the busier districts. On the whole metropolitan area the average yield per mile is 1 cub. yd. of slop, $\frac{1}{4}$ cub. yd. of catchpit and other deposit, and $\frac{3}{4}$ cub. yd. of dust. But nearly the whole of this deposit in the gulleys is the consequence of negligent scavenging of the streets, or of improperly-made roads. For instance, while in the City it does not exceed $\frac{1}{10}$ of the slop, in Chelsea it forms, or formed till recently, over 40 °/₀ of the total.

Street Watering.

The purpose of watering is twofold, viz. cleansing and the prevention of dust, the former being necessary, except in wet weather, as a preliminary to sweeping, the latter only in really dry and warm weather. The London companies charge by meter at the rate of 9*d.* per 1000 gallons, and the rent of the meters, £2 2*s.* per annum, in connection with hydrants, and 10*s.* for small ones in urinals, though in some districts these are provided by and are the property of the L.A.

Watering is usually carried out from March to September inclusive; Bayley's Hydrostatic Van (or some imitation of it) is now almost everywhere used in place of the old water-cart. Though its capacity, 450 galls., is more than double, it is less fatiguing to the horse, and it effects a corresponding saving of time in going to and from the stand-pipes.

The first watering of the main thoroughfares of traffic is done early in the morning before the sweeping, and this is immediately followed by a second, the flags in some districts and the asphalt in the City being cleaned by "squeegees" instead of brooms; mechanical sweepers drawn by a horse are in every way more efficient and speedy, especially on granite, than hand-sweeping, the line of mud swept by the machine to each side of the road being shovelled into the slop-cart following behind. The watering is repeated during the day as often as circumstances may require, regulating the hours by the exigencies of the traffic. In quiet streets two or three waterings, the first early in the morning, and the second during the noon-day lull, are generally sufficient, but much economy may be effected by having regard to the incidence of the sun's rays, as those streets which are in the shade will be slower in drying. Thus, in the morning, streets running north and south should be watered before those running east and west, and the order reversed in the mid-day watering. Mere "laying the dust" is a useless waste; and if the roads be kept well swept it is scarcely possible to use too much water.

In many maritime towns sea-water is now employed with the most satisfactory results, not only on account of its costing nothing, but of the tendency of the salts to retain moisture; and several proposals have been put forward for the use of deliquescent salts, as chlorides, which serve in like manner to keep the ground moist, to fix the ammonia of the manure, and to destroy any ill odours.

Washing the footways, and wood and asphalt pavings, especially in narrow streets, by means of hose and hydrants, first tried by Mr. Lovick at Leeds nearly fifty years ago, has been adopted with the best results in the City, where courts and alleys are also washed down twice or thrice a week. In Edinburgh, Dr. Littlejohn has followed the practice extensively in the alleys, or "wynds" as they are there called. At the ordinary pressure one gallon is reckoned to effectually cleanse a square yard of paving, but Mr. Lovick considered that with "a very high pressure," a half or even a third of a gallon was amply sufficient, while the cost is considerably less than that of the usual methods of scavenging. In the City of London the washing of wood and asphalt is performed during the night, when there is little or no traffic.

Removal of Snow.

Until the passing of the P.H.(L.)A. 1891 the duty of clearing the snow from the footways was imposed on the occupiers of the houses, and if not evaded, inflicted a heavy tax on the householders, in the exorbitant charges made by the men who offered their services. Henceforth it devolves on the Local Authorities to remove the snow from the footways at the same time as from the roads, though at present it cannot be said that they have performed their new task satisfactorily. Indeed, making all allowance for the sudden strains on their resources, and the difficulty of finding in so large a city vacant places for depositing the snow, except in those districts within easy distances from the Thames, the helplessness of the L.A.s on the occasion of a heavy fall is inexcusable. The personal inconvenience and pecuniary loss consequent on the recurring interference with locomotion and traffic is a serious matter. Yet each winter finds them as unprepared as they would be for an earthquake or a water-spout.

Our municipal authorities would do well to copy the example of those of Berlin, Vienna, and Milan, as well as of other continental, especially German, towns, where a permanent service is organized for the purpose. It is easy to remove the snow while fresh and soft, but when frozen, compressed, and trodden down it is difficult, and on flagged footways well-nigh impossible, so that prompt and early action is imperative. The German and Italian plan is for the corporation to provide plant and tools, ready for use, in several depôts in different quarters of the town, which is divided into a number of districts, such that each can be cleared of snow within twenty-four or thirty-six hours. Each district is entrusted to a contractor, who besides a certain number of the men in his regular employment as foremen and assistants, keeps a register of labourers from among whom he can call out at an hour's notice as many as he may need. They are for the most part men connected with building trades, and ground labourers, men who are generally thrown out of employment at such times, and who can be trusted to do the work far more efficiently than the casuals and paupers to whom our authorities have recourse.

Salting and Gravelling.

The density of new-fallen snow varies extremely, the weight of a cubic yard having been found by Prof. Clericetti and Mr. E. B. Sormani, the City Engineer of Milan, to range from 70 lbs. to 815 lbs., but its removal is easy enough at first. It is only when it has been allowed to lie that there can be any pretext for salting. The intense cold produced by the melting of the snow with salt does not, it is true, persist long, the brine acquiring in a short time the temperature of the air; but, apart from the immediate danger of chill, boots into which it penetrates cannot be dried, the salt absorbing moisture for an indefinite period. The practice cannot be too strongly deprecated, and if it must be resorted to for the purpose of melting hardened snow, the slush should be completely removed by copious washing and mechanical sweeping, followed by a liberal application of sand and gravel.

Market Refuse.

Market refuse, including that from slaughter-houses, butchers', fishmongers', fruiterers', and greengrocers' shops, as well as that collected from around the costermongers' stalls, consists of vegetable refuse, damaged fruit, &c., butchers' and fish offal, bad fish, meat, fruit, &c., condemned as unsound by order of a J.P., and blood, the passage of which into drains and sewers is illegal. In London and some large towns the blood-boiler and drier relieves the S.A. of responsibility, since for his trade purposes he requires the blood while still fresh and inoffensive, while the fish manure, superphosphate, and chemical manure manufacturers, tallow and soap-boilers, candle works, bone-boilers, glue-makers, &c., collect a large proportion of other animal refuse, the L.A. having only to see that the transport of the raw material through the streets and the manufactures themselves are conducted with due care to avoid nuisances. The disposal of the rest will be discussed in another place, here I shall only remark that it would be better for the S.A. to undertake the collection of all the less saleable refuse than to commit it to contractors, who, if they do not neglect to collect it, are apt to create fresh nuisances by depositing it on waste lands and other improper places.

Trade Refuse.

It is impossible to enumerate the multifarious matters coming under this head, which will be different in every place: some however are common to all towns, as clinkers from furnaces, waste-paper and packing materials, shavings and saw-dust, rags, &c., &c. Paper manufacturers buy up a good deal; the rest of the dry vegetable refuse, as packing, is easily burnt; and clinkers are always in request for road-making; besides, the fact that the L.A. is authorized to charge for the removal of trade refuse avoids any serious expense in its collection.

DISPOSAL AND UTILIZATION OF REFUSE.

Street Refuse.

Shooting.—Where there is within a distance such that the cost of carriage by road or rail would not be prohibitive, any considerable extent of waste and useless land capable of being reclaimed,—sea foreshores, shallow estuaries, salt or fresh-water marshes,—the simplest mode of disposing of the "slop" and "dust" would be to shoot it in its crude state on such sites, looking for a return in the future enhanced value of the land thus made available for culture. The extent of land in different parts of the country, especially on the south and east coast, available for such treatment, which when the distance is under ten miles might be advantageously combined with sewage irrigation, is far greater than is commonly supposed.

Sale of Street Refuse for Manure.

If, as I strongly advise, the horse-droppings were collected by street orderlies before being broken down by the traffic, slop would by itself have no market value as such, though on the other hand its bulk would be reduced by half, and it would be inoffensive; while it would be more readily submitted to the washing process shortly to be described. Even as it is, crude street-sweepings are saleable as manure, but when one considers that, to take Paddington as an illustration, the price obtainable for street sweepings containing 50 % on the average of horse-droppings, raised by the admixture of an equal bulk of stable-dung to 75 %, is from 5*d.* to 3*s.* 6*d.* per ton, and that good stable manure will fetch from 2*s.* 6*d.* to 5*s.* per ton, while horse-droppings without straw and other inert matters are worth considerably more, it seems evident that it would be better in every way to keep the three distinct, and to dispose of them separately at their several values.

Sifting Process.

Some twenty or thirty years ago the L.A.s of the suburban districts had little or no difficulty in disposing of the whole of their "dust" at a fair profit to the brickmakers and builders who were then developing outer London; but as the field of operations became more extended and the clay or brick-earth available on the spot exhausted, their position changed; the excess of the supply over the demand and the cost of carriage compelled them to devise methods of reducing the bulk and enhancing the value of the constituents by attempts at separation and sorting. The most generally adopted, alike in the metropolis and the provinces, is the "sifting process," or separation of the coarser parts from the finer ash and dust, by passing it through large circular sieves. This is performed by hand labour, mostly female, and is so filthy and loathsome a work that the substitution of some mechanical treatment is a moral duty. The coarser portion consists of clinkers, bottles, old metal, crockery, paper, corks, bones, rags, string, &c., &c., which are carefully sorted into heaps to be disposed of separately. The bottles fetch about 9*d.* the gross, paper 25*s.* to 30*s.*, rags 20*s.*, bones 50*s.*, and iron 20*s.* the ton, other metal 18*s.* the cwt., tinware 3*s.* the cart-load, and so on. The other materials are distinguished as "breeze," or cinders and fragments of unburnt coal; "hard core," broken crockery and bottles, clinkers, oyster-shells, &c.; and "soft core," or animal and vegetable matters, useless rags, &c.

"Breeze" and fine ash mixed are sold to brickmakers at about 2*s.* the chaldron around London. "Hard core" is used, or in the older districts where there is no local demand sold, for road-making, but in the City large sums have to be paid to the contractors for its removal. "Soft core" is the most embarrassing to the authorities. In most places it is, together with market refuse, bad fish, offal, "slop," &c., mixed with the horse-droppings and stable manure, and sometimes sold to farmers at 1*s.* the ton, or more often given away. This adulteration and gross deterioration of the very finest natural manure, which would be eagerly bought up by gardeners and florists, until its market value is almost nil, is indefensible except on the plea that it provides for the disposal of a mass of worthless but offensive organic matter, which could not be otherwise got rid of, and which cannot be burnt in the furnace, as are all dry woody refuse, baskets, matting, shavings, and rags not available for the paper manufacturer.

In Newington the mixture of manure and refuse has proved less wasteful, owing to the combination of circumstances, viz. cheap carriage, and poor, stiff, agricultural land for utilizing the mixture within an accessible distance. The sale is regular, orders are booked several months in advance, and the price, 3*s.* to 3*s.* 6*d.*, tends to rise, while it is stated that poor lands, letting at no more than 12*s.* the acre, have by its help yielded crops equal to the best.

The manufacture of "Newington Mixture" is as follows. In a large paved and guttered yard a bank is raised of stable manure and soft core, forming a hollow square, into which, as into a tank, slop, mud, &c., are poured until it is half full. The water having run off, it is filled up with stable manure and soft core, and the whole well mixed.

Where the "pail system" is still in vogue, the night-soil is mixed with street sweepings and dust, and thus constitutes a very saleable manure, but the time cannot be far distant when pails and all such "dry" methods will be superseded in the northern, as they have long since been, in the southern towns, by some serviceable form of water-closet.

In some maritime towns, as Liverpool, no attempt is made to utilize dust and slop, which is carried out to sea, after the hard core has been separated; the stable manure having been disposed of separately.

Islington Washing Process.

By far the greatest portion of the roads in this large parish are macadamized, and the slop is subjected to a process of washing in pug-mills driven by steam-power, and subsequent filtration. The stones and sand or grit remain in the mill, and the mud on the filter: the stones, forming about 10 °/o, fetch 6*s.* per cub. yard, the sand, 40 °/o, 2*s.* 6*d.*, and the mud, a sandy loam, 50 %, 6*d.* the ton. Much of the stones and sand is used by the Borough Council for road-making.

Cremation.

As with the disposal and utilization of sewage, it is unreasonable to look for a profit, that is, to make it a commercial success. The cost of any process is the price paid for securing purity of air, soil, and water, and any proceeds that may be realized must be taken as "set-offs," as a saving in the expenses of scavenging. Even the destruction of that, the removal or disposal of which involved a heavy expenditure, is *pro tanto* a gain to the rates.

Cremation, as carried out by Messrs. Manlove, Alliott & Fryer, of Nottingham, in a number of large towns at home and abroad, consists of the complete combustion of all organic and fusion or incineration of inorganic refuse in a series of reverberatory furnaces, called the Destructor. The dust, slop, &c., is tipped from above on to the hearth in front of each furnace proper, while the clinkers are withdrawn from behind, and the dried refuse pushed into the furnace every two or three hours.

Each cell consumes seven tons of refuse in twenty-four hours, reducing it to from $\frac{1}{4}$ to $\frac{1}{7}$ of its weight, according to its nature and composition. In the north, where coal is cheap and used somewhat lavishly, the "breeze" provides all the fuel required, but in the south of England the "dust" contains less coal, and some has to be added occasionally. The chimney must be capacious and not less than 160 to 180 feet high, or a certain amount of fine dust will be carried out with the draught, unless some "scrubbing" process, as Elliott's, is adopted.

The waste heat of the gaseous products of combustion may be utilized to raise steam in a multitubular boiler, giving, at a pressure of 40 lbs. to the inch, driving power to a 14 h.p. horizontal engine, which works two mortar-mills with 8 ft. pans, in which so much of the clinker as is not wanted for road-making is ground with lime into a powder, which makes a very tenacious mortar. It sells readily at 4*s.* 6*d.* to 5*s.* the ton, giving a clear profit of 1*s.* to 1*s.* 6*d.* on each. Each mill will turn out 8 tons daily.

The Carbonizer, which is not an essential feature, and advisable only where there is much vegetable (market) refuse, and a sufficient demand for charcoal, consists of a series of vertical furnaces lined with alternating and overlapping baffle-plates of cast iron, down the red-hot surfaces of which the refuse, shot in from above, slides into the body of the furnace as the preceding charges are burnt and withdrawn.

Some fuel, breeze, is required at starting, the heat of the gases is utilized to the utmost within the furnace itself, and the exclusion of air during the process, which is continuous, is of course essential to the aim in view, viz. carbonizing or incomplete combustion of the refuse. The incandescent charcoal is withdrawn every two hours and cooled in revolving cylinders, over which a stream of cold water flows constantly. Each cell will carbonize 4½ tons of refuse daily, and the product in some towns fetches as much as 20*s.* the ton. Complaints are sometimes raised of effluvia, but no nuisance need arise if the furnaces consume their own smoke, and are properly stoked.

The entire cost of installation of a six-celled Destructor, an eight-celled Carbonizer, with steam-engine, mortar-mills, and the necessary buildings, is about £4500, while the saving effected on the older methods of disposal in any large towns exceeds that sum in the first year. But whether the process can be made profitable, or the heat be utilized as a source of power, depends on the possibility of dispensing with extraneous fuel; easy in the north of England, and wherever the cheapness of coal leads to much waste, but not in the south and east.

Condemned Meat.

Fish when unfit for food is easily disposed of either to be applied directly to the land, or for chemical treatment and conversion into an artificial manure. But condemned meat is by no means so saleable, from the inconvenience of its form. In Deptford, indeed, it is cut up and mixed with slop and offal, to form a disgusting compost, the pestilential stench of which may be perceived for miles on the roads and fields of Essex.

Dr. Sedgwick Saunders, M.O.H. to the City of London, has suggested a treatment of the meat by the Sanitary Authority itself, that would give the largest returns with little or no nuisance. The fat being the most valuable portion of the carcass, its removal by the butcher should on many grounds be prohibited. The carcasses should be steeped in a bath composed of—

Calcium Chloride	2 cwt.
Sodium Chloride (common salt) ...	½ ,,
Sulphate of Iron	1 ,,
Picric Acid	2 lbs.
Water	300 galls.

This highly-antiseptic solution stains the flesh a deep yellow, but if long in use the picric acid must be replenished from time to time.

Subjected to steam in an "Extractor," 10 °/o to 12 °/o of fat will easily be obtained, and if the whole carcass, including the bones, have been comminuted by Dr. Saunders's "Devil," the product will reach 15 °/₀ of pure, clarified fat, worth at all times over £30 the ton.

The meat fibre, dried and pulverized in appropriate apparatus, forms a powerful fertilizer, which with 8 °/₀ of ammonia-yielding matter, will fetch at least £8 per ton from farmers.

The bones, worth £5 per ton when wet, form 10 °/₀ of the condemned meat, and may be sold separately or mixed with the meat fibre, to the manurial value of which they greatly add. The apparatus required are Dr. S. Saunders's Carcass Crusher, which will reduce a horse to mincemeat, bones and all, in 30 seconds, and a couple of Firman's Rotatory Rendering Machines, by which the fat is completely extracted and the residue reduced to a dry brown cocoa-like powder, almost free from smell, and capable of being kept in bags or sacks without danger or offence. Each machine consists of a horizontal cylinder, steam-jacketed, and having inside a revolving axis with steam-heated arms and scrapers, by which the meat is kept in constant agitation. The cylinders are connected with a high-pressure Root's boiler, a condenser, and an air-pump. In the first stage, in which the cylinder is charged with steam at ordinary pressure, the fat is "rendered" or melted out, and the steam having been shut off is drawn away through cocks at different levels. In the second stage the pressure is raised to 50 lbs. and the temperature to 300° F., reducing the flesh to a pulp, and dissolving the gelatine from the bones. In the last or drying process the air-pump is brought into action, and under a partial vacuum, at a temperature of 175° F., the desiccation is carried on until not more than 8 °/₀ to 10 °/₀ of moisture remains.

Two products only are attempted, but these two, clarified fat and an artificial guano, always command good prices. The whole process being carried on in a closed chamber, and the gases or vapours passed into the furnace, there is nothing of the nature of a nuisance to be feared.

It has been partially adopted at Rochdale and Warrington, where Firman's Dryers are in constant use for the treatment of the stuff from pails and middens.

Mechanical Sifting of Refuse.

A very interesting procedure was inaugurated by a firm bearing the name of the Refuse Utilization Company, at Lott's Road, Chelsea, near Walham Green. It consists in the substitution of mechanical for manual labour, in the sorting and sifting of "dust" or house refuse, which is effected in closed drums instead of by open sieves, thus avoiding the degrading and sickening labour, performed elsewhere by wretched and necessarily ill-paid women. The refuse is utilized for a variety of purposes, brown paper being the leading product of the undertaking.

PART II.

SANITARY LAW.

Prefatory Note.

In the following pages will be found an abstract of so much of the Public Health and other Acts in force in the United Kingdom, England, and London, as bears on the duties and powers of the Health Officer, with references to those of Scotland and Ireland.

The General Plan of this part has been explained in the Preface, but I may here further observe, that there are two Acts which more than any others partly coincide with and overlap one another—the Public Health Act of 1875, and the Public Health (London) Act of 1891. These I have treated together so far as possible. I have first given the London Act in full; then in the form of notes I have indicated the corresponding sections of the older Act, numerically only when identical, and when not so, pointing out the differences between them; lastly, I have given in order the Titles of the sections of the Public Health Act, referring numerically to the corresponding sections of the London Act, and giving those that havo no counterparts in that Act, more or less fully. Dealing in like manner with the Public Health Amendment, Infectious Diseases Prevention and Notification Acts, I have avoided the repetition of those sections that have been either taken from the Public Health Act of 1875, or incorporated into that of 1891.

I have introduced so much of the Met. Loc. Manag. Acts 1855 and 1862 as has not been repealed by the Pub. Health and London Government Acts, and a short abstract of the Pub. Health (Scotland) Act, 1897, so far as its provisions are in advance of the Pub. Health (London) Act.

I have substituted the Diseases of Animals Act, 1894, for that of 1878, which it has superseded; and have added the Isolation Hospitals Act, 1893, the Sale of Foods Act, 1899, and the Amending Infectious Diseases Notification and Housing of the Working Classes Act, 1900, making the necessary changes in the older Acts.

Subjoined is a list, in alphabetical order, of the abbreviations used in the following Abstract of Sanitary Laws:—

List of Abbreviations.

(*For those used for Acts of Parliament, see next page.*)

Advt.; Advertisement.
A.O.; Abatement Order.
a.p.; ashpit.
B.A.; Board of Agriculture.
B.L.; Bye-Law or Bye-Laws.
C.A.; Confirming Authority.
C.C.; County Council.
C.G.S.; Court of General Sessions.
C.O.; Closing Order.
C.P; Contributory Place.
C.P.; Cattle Plague.
c.p.; cesspits.
C.Q.S.; Court of Quarter Sessions.
C. of S.; Commissioners of Sewers.
C.S.J.; Court of Summary Jurisdiction.
D.I.D.; Dangerous Infectious Disease.
D.O.; Demolition Order.
D.P.; Daily Penalty: < not exceeding: > not less than.
d.p.; dungpit.
e.c.; earth closet.
F.M.D.; Foot & Mouth Disease.
G.O.; General Order.
I.; Inspector.
I.A.; Infected Area.
I.D.; Infectious Disease.
I.P.; Infected Place.
I.S.; Improvement Scheme.
J.P.; Justice of the Peace.
L.A.; Local Authority.
L.B.; Local Board.
L.C.C.; London County Coun.
L.D.; Local District.
L.G.B.; Local Govern. Board.
L.I.; Local Inquiry.
L.S.A.; Local Sanitary Authority.
M.A.B.; Metropolitan Asylums Board.
M.A.M.; Metr. Asyl. Managers.
M.M.; Medical Man.
M.O.; Medical Officer.
M.O.H.; Med. Officer of Health.
N.O.; Nuisance Order.
O.; Owner.
O.; Occupier.
O.C.; Order in Council.
O.R.; Official Representation.
p.; privy.
P.C.; Privy Council.
P.I.E.; Private Improvement Expenses.
P.O.; Prevention Order.
Prov. O.; Provisional Order.
P.P.; Pleuro-Pneumonia.
P.S.A.; Port Sanit. Authority.
P.S.C.; Petty Sessional Court.
Q.S.; Quarter Sessions.
R.A.; Rural Authority.
R. & C.C.; Railway and Canal Commissioners.
R.D.; Rural District.
R.D.C.; Rural District Coun.
Rg.; Regulations.
R.S.A.; Rural San. Authority.
R.S.D.; Rural San. District.
S.A.; Sanitary Authority.
s.c.; sanitary convenience.
S.F.; Swine Fever.
S.I.; Sanitary Inspector.
S.O.; Special Order.
S.S.; Secretary of State.
U.A.; Urban Authority.
U.A.; Unhealthy Area.
U.D.; Urban District.
U.D.C.; Urban District Coun.
U.H.H.; Unfit for Human Habitation.
U.S.A.; Urban San. Authority.
U.S.D.; Urban San. District.
V.I.; Veterinary Inspector.
w.c.; water-closet.
W.C.; working classes.
W.Co.; Water Company.
W.W.; Water Works.

Abbreviations used for Acts of Parliament.

A.A.	Alkali Acts, 1863, 1874 (Consolidated) ...	1881
C.B.A.	Canal Boats Acts	1877–84
C.D.(A.)A.	Contagious Diseases (Animals) Act ...	1878
C.L.H.A.	Common Lodging Houses Acts ...	1851, &c.
D.A.A.	Diseases of Animals Act	1894
D.C.M.O.	Dairy, Cowshed and Milk Shop Orders ...	1885–6
F.W.A.	Factories and Workshop Acts ...	1878–1891
H.W.C.A.	Housing of Working Classes Acts	1890–1900
I.D.(N.)A.	Infectious Diseases (Notification) Acts	1889–1899
I.D.(P.)A.	,, ,, (Prevention) Act ...	1890
I.H.A.	Isolation Hospitals Act	1893
L.C.(C.)A.	Land Clauses (Consolidation) Acts	1845, &c.
L.G.A.	Local Government Acts	1888–1894
M.L.M.A.	Metropolis Local Management Acts	1855–1862
M.W.C.A.	,, Water Companies Act ...	1871
P.H.A.	Public Health (England) Act	1875
P.H.(A.)A.	,, ,, (Amendt.) ,, ...	1890
P.H.(I.)A.	,, ,, (Ireland) ,, ...	1878
P.H.(L.)A.	,, ,, (London) ,, ...	1891
P.H.(S.)A.	,, ,, (Scotland) ,, ...	1897
P.H.(W.)A.	,, ,, (Water) ,, ...	1878
P.W.L.A.	Public Works Loans Act	1879
R.P.A.	Rivers Pollution Acts	1876–1898
S.F.D.A.	Sale of Food and Drugs Acts	1875–1879–1899
S.J.A.	Summary Jurisdiction Acts	Various

PUBLIC HEALTH (LONDON) ACT, 1891.

The sections marked ** are wholly and those marked * partly new.

SEC.
1 S.A. to inspect district for detection of nuisances.

Nuisances (General).

2 What nuisances may be abated summarily.
3 Information of nuisances to S.A.
4 Notice requiring abatement of nuisance.
5 On non-compliance with notice, order to be made.
6 Provision as to appeal against order.
7 Provision in case of two convictions for overcrowding.
8 In certain cases, order may be addressed to S.A.
9 Power to sell manure, &c.

SEC.
10 Power of entry.
11 Cost of execution of provisions relating to nuisances.
12 Power of individual to complain to Justice of a nuisance.
13 Proceedings in High Court for abatement of nuisances.
14 Power to proceed where cause of nuisance arises without the district.
**15 Penalty for injuring closets, &c. so as to cause a nuisance.

Penalties in respect of particular nuisances.

16 Bye-laws by S.A. and C.C. as to cleaning streets and prevention of nuisances.
17 Penalty for keeping swine in unfit place.
**18 Power to prohibit keeping animals in unfit places.

Offensive Trades.

*19 Prohibition and regulation of establishing anew certain offensive businesses, and byelaws as to the same.
**20 Licensing of cow-houses and slaughter-houses.
*21 Duty of S.A. to complain to Justice of nuisance arising from offensive trade.
**22 Provision as to nuisance created by S.A. in dealing with refuse.

Smoke Consumption.

23 Furnaces and steam-vessels to consume their own smoke.
24 Summary proceedings for abatement of nuisance caused by smoke.

Workshops and Bake-houses and Dairies.

**25 Lime-washing and cleansing of workshops.
**26 Enactments respecting bake-houses.
**27 Notice to Factory Inspector respecting children and women in workshops.
**28 Orders and regulations for dairies.

Removal of Refuse.

**29 Duty of S.A. to cleanse streets.
*30 Removal of house refuse.
**31 S.A. to appoint scavengers.
**32 Disposal of refuse.
33 Owners, &c., to pay for removal of trade refuse.
34 Provision on neglect of scavengers to remove dust.
35 Removal of filth on requisition of S.A.
*36 Removal of refuse from stables, cowsheds, &c.

Regulations as to Water-closets, &c.

SEC.
*37 Obligation to provide water-closets, &c.
38 Sanitary conveniences for manufactories, &c.
**39 Bye-laws as to water-closets, &c.
40 Power of S.A. to authorize examination of w.c.'s, &c.
41 Penalty for improperly making or altering w.c.'s, &c.
**42 Improper construction or repair of water-closet or drains.
**43 S.A. to cause offensive ditches, drains, &c., to be cleaned or covered.
44 Power to S.A. to provide public conveniences.
**45 Regulations as to public sanitary conveniences.
**46 Sanitary conveniences used in common.

Unsound Food.

**47 Inspection and destruction of unsound meat, &c.

Provisions as to Water.

**48 Provision as to house without proper water supply.
**49 Notice to S.A. of water supply being cut off.
**50 Cleansing of cisterns.
51 Power of S.A. as to public fountains.
52 Penalty for causing water to be corrupted by gas-washings.
**53 Penalty for fouling water.
54 Power to close polluted wells, &c.

Infectious Diseases—Notification.

I.D.(N.)A.
55 3, 4, 6, 10, 13, 14, Notification of infectious diseases.
56 7 Power of S.A. to add to number of infectious diseases notification of which is required.
57 11 Non-disqualification of M.O. by receipt of fees.

Infectious Diseases—Prevention.

I.D.(P.)A.
**58 Application of special provisions to certain *I.D.*
59 Provision of means for disinfection of bedding, &c.
60 5, 15, 17 Cleansing and disinfecting of premises, &c.
61 6 Disinfection of bedding, &c.
62 13 Infectious rubbish, &c. thrown into ashpits, &c., to be disinfected.
63 Penalty on letting houses in which infected persons have been lodging.
64 Penalty on persons letting houses making false statements as to infectious disease.
65 7-14 Penalty on ceasing to occupy house without disinfection or notice to owner, or making false answer.

SEC.	I.D.(P.)A.	
66		Removal to hospital of infected persons without proper lodging.
67	12	Detention in hospital of infected person without proper lodging.
68		Penalty on exposure of infected persons and things.
**69		Prohibition of infected persons carrying on business.
70		Prohibition of conveyance of infected persons in public conveyances.
71	4	Inspection of dairies, and power to prohibit supply of milk.
72	8	Prohibition of retention of dead body in certain cases.
73	9	Body of persons dying of infectious disease in hospital to be removed for burial.
74	11	Disinfection of public conveyances if used for carrying corpses.

Hospitals and Ambulances.

SEC.	
75	Power of S.A. to provide hospitals.
76	Recovery of cost of maintenance of non-infectious patients in hospital.
77	Power to provide temporary supply of medicine.
78	Provision of conveyance for infected persons.
** 79	Power for M.A.B. to provide landing-places, vessels, ambulances, &c.
** 80	Reception of non-pauper fever and small-pox patients into hospital in metropolitan district.
** 81	Reception into hospital in metropolitan district of child from school outside London.

Prevention of Epidemic Diseases.

SEC.	
82	S.A. to execute epidemic regulations.
83	Poor-law medical officers entitled to charge for attendance on board vessels.
84	L.G.B. may combine S.A.s.
** 85	M.A.M. a S.A. for prevention of epidemic diseases.
** 86	Power to let hospitals, &c.
** 87	Repayment to S.A. of certain expenses.

Mortuaries, &c.

SEC.	
88	Power of L.A. to provide mortuaries.
89	Power of Justice in certain cases to order removal of dead body to mortuary.
90	Power of S.A. to provide places for post-mortem examination.

SEC.
** 91 Power of S.A.s to unite for providing mortuary.
** 92 Place for holding inquests.
** 93 Mortuary for unidentified bodies.

Bye-laws as to Houses let in Lodgings, &c.

94 Power of S.A. to make B.L. as to lodging-houses.
** 95 Tents and vans used for human habitation.

Underground Rooms.

* 96 Provisions as to the occupation of underground rooms as dwellings.
** 97 Enforcement of provisions as to underground rooms.
98 Provision in case of two convictions for unlawfully occupying underground room.

Authorities for Execution of Act.

** 99 Definition of S.A.
**100 Power of C.C. to prosecute on default of S.A.
*101 Proceedings on complaint to L.G.B. of default of S.A.
**102 Application of Public Health Acts to Woolwich.
**103 Expenses of execution of Act.
**104 Expenses of M.A.B.
**105 Power of vestries and district boards to borrow.
*106 Appointment of M.O.H.s.
**107 Appointment of S.I.s.
108 Provisions as to medical officers and sanitary inspectors.
109 Temporary arrangement for duties of M.O.H. or S.I.
110 Jurisdiction as to ships.
**111 P.S.A. of port of London.
**112 Powers of P.S.A. of port of London.
113 Powers of L.G.B. as to epidemic diseases.
114 Bye-laws.

Legal Proceedings, &c.

115 General provisions as to powers of entry.
116 Penalty on obstructing execution of Act.
117 Summary proceedings for offences, expenses, &c.
**118 Evidence by defendant.
**119 Application of fines and disposal of things forfeited.
120 Proceedings in certain cases against nuisances.
121 Recovery of expenses by S.A. from O. or *O.*
122 Justice to act though member of S.A., or liable to contribute.
123 Appearance of S.A. in legal proceedings.
124 Protection of S.A. and officers from personal liability.
125 Appeal to Q.S.

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126 Provisions as to appeal to C.C.
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128 Service of notices, &c.

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129 Inquiries by L.G.B.
130 Forms.
**131 Lewisham and Penge.
132 Extent of Act.

City of London.

**133 Application of Act to city.
134 Power of city police to proceed in certain cases against nuisances.
135 Proceedings on complaint to L.G.B. of default of C.S.

Saving Clauses.

**136 Saving for water rights.
**137 Saving for Thames Conservators.
**138 Powers of Act to be cumulative.

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**139 Existing officers.
**140 Existing members of Woolwich Board.

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141 Interpretation of terms.
**142 Repeal of enactments in schedule.
**143 Commencement of Act.
**144 Short title.
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PUBLIC HEALTH (AMENDMENT) ACT, 1890.

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5 Power of L.G.B. to extend Act to rural districts.
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19 Extension of P.H.A., § 41.
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21 Sanitary conveniences used in common.
22 Sanitary conveniences in manufactories, &c.
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28 Extension of P.H.A., §§ 116—119.
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30 Notice of change of occupier of slaughter-house.
31 Revocation of licence on conviction for sale, &c., of meat unfit for food.
32 Extension of P.H.A., § 84.
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12 Vesting of property in local authorities.

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14 Power to purchase Sewers.
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16 Powers for making sewers.
17 Sewage to be purified before being discharged into streams.
18 Alteration and discontinuance of sewers.
19 Cleansing sewers.
20 Map of system of sewerage.
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22 Use of sewers by owners and occupiers without district.
23 Power of L.A. to require houses to be drained into new sewers.
24 Power of L A. to require houses to be drained.
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26 Penalty on unauthorized building over sewers and under streets in urban districts.

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35 Penalty on building houses without privy accommodation.
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40 Drains, privies, &c., to be properly kept.
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43 Penalty on neglect thereof.
44 Power to make bye-laws imposing duty on occupier.
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47 Penalty in respect of certain nuisances on premises.
48 Provisions for obtaining order for cleansing offensive ditches lying near to or forming boundary of district.
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53 As to construction of reservoirs.
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55 As to supply of water.
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58 Power to supply water by meter.
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60 Penalty for injuring meter.
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64 Vesting of public cisterns, &c., in L.A.
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69 L.A. may take proceedings to prevent pollution of streams.
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71 Prohibition of occupying cellar dwellings.
72 Existing cellars to be occupied only on certain conditions.
73 Penalty on persons offending against enactment.
74 Definition of occupying as a dwelling.
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76 Registers of common lodging-houses to be kept.
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79 Notice of registration to be affixed to house.
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83 Power to order reports from keepers of houses receiving vagrants.
84 Keepers to give notice of fevers, &c., therein.
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86 Offences by keepers of common lodging-houses.
87 Evidence as to family in proceedings.
88 Conviction for third offence to disqualify persons from keeping common lodging-houses.
89 Interpretation of "common lodging-house."
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94 L.A. to serve notice requiring abatement of nuisance.
95 On non-compliance, complaint to be made to justice.
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97 Order of prohibition in case of house unfit for habitation.
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106 Power of police to proceed in certain cases of nuisance.
107 L.A. to take proceedings in superior court.
108 Power to proceed where nuisance arises out of district.
109 Provision in case of two convictions for over-crowding.
110 Provision as to ships.
111 Provisions of Act relating to nuisances not to affect other remedies.

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112 Restrictions on establishing such in urban district.
113 Bye-laws as to such in urban district.
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116 Power of M.O.H. to inspect and seize meat, &c.
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119 Search warrant may be granted by justice.

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120 Duty of L.A. to cause premises to be cleansed and disinfected.
121 Destruction of infected bedding, &c.
122 Provision of means of disinfection.
123 Provision of conveyance for infected persons.
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125 Removal of persons brought by ship.
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129 Penalty for letting such houses on false statements.

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131 Power of L.A. to provide infectious hospitals.

132 Recovery of cost of maintenance of patient in hospital.

133 Power to provide a temporary supply of medicine.

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135 Publication of regulations and orders.

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138 Poor-Law M.O. entitled to charge for attendance on board vessels.

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140 Penalty for violating or obstructing execution.

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141 Power of L.A. to provide mortuaries.

142 Justice may in some cases order removal of body to mortuary.

143 Power of L.A. to provide post-mortem room.

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12 Notice of mixture not to be obscured.
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19 Repeal and amendment of S.F.D.A., 1879, § 10.
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8 Powers of S.A. to enforce Act.
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DISEASES OF ANIMALS ACT, 1894.

1 Board of Agriculture is confirming authority.
2—3 Local authorities to execute Act.
4 Isolation and notification of diseased animals.
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6 Declaration of infected place or area by Board of Agriculture.
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10 Powers of Board in respect of other diseases.
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17 Appointment by Board of additional inspectors.
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19 Slaughter and compensation in other diseases.
20 Disposal of carcases of slaughtered animals.
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22 Board may make orders on any matters within the scope of the Act.
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31 Mutual relations of authorities.
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34 Board may intervene in case of default of Local Authority.
35 Appointment of veterinary and other inspectors by Local Authority.
36 Reports, &c., by Local Authority to Board.
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46 Disposal of carcases washed ashore.
47 No charge for appointment, licence, or certificate.
48 Service of notices, &c.
49 Publication of orders, &c.
50 Yearly return to Parliament.
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52 Offences and their penalties in respect of carcases.
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54 Proceedings to be taken in court of summary jurisdiction, except under Customs Act.
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Schedules.

I. Provisions in respect of—Part 1, pleuro-pneumonia; Part 2, foot-and-mouth disease.
II. Financial; pleuro-pneumonia accounts for Great Britain and Ireland.
III. Foreign animals; provision for slaughter or quarantine.
IV. Constitution and procedure of joint committees under sec. 39.

CONTAGIOUS DISEASES (ANIMALS) ACT, 1878.

Repealed, except—
Sec. 34 Registration and regulation of dairies, cow-sheds, and milk-shops.

HOUSING OF WORKING CLASSES ACT, 1900.

SEC.
1 Adoption of Part III. of principal Act by Councils other than Rural Councils.
2 Adoption by Rural Councils.
3 Expenses of Metropolitan Borough Councils.
4 Expenses and receipts of re-housing.
5 Delegation of re-housing to private persons.
6 Appeals by Parish Councils to County Council in case of default of Rural District Council.
7 Arbitration in acquisition of land.

METROPOLIS LOCAL MANAGEMENT ACTS, 1855 AND 1862.

The greater part of these Acts has been repealed and superseded by the P.H.(L.)A., 1891, *and Lcl. G.A.*, 1899, *and of the sections still in force the larger number deal with the conduct of business, paving, lighting, finance, &c., with which the M.O.H. and S.I. have little if any concern. The unrepealed Sanitary Sections only are given here.*

M.L.M.A., 1855.

SEC.
68 All sewers, except main sewers, vested in L.A.
69 Repair, maintenance, &c., of same by L.A.
70 Liability of certain parties in certain cases.
71 Trapping, ventilation, &c., of sewers by L.A.
72 Cleansing of sewers by L.A.
73 Houses to be connected with sewer if within 100 feet.
74 Combined drainage permitted in certain cases.
75 No house to be built without proper drains.
76 Notice to be given before digging for foundations or drains.
78 L.A. may do so much of private drains as necessitates opening up street.
79 L.A. may contract with owners to make whole of drains.
82 Inspection of drains, &c., by S.I.
83 Penalties for improperly making or altering drains.
84 When found sound cost and damage to be paid by L.A.
85 When defective to be made sound and efficient.
87 Filling up ditches and laying of pipe drains.
98 L.A. to cause streets to be paved.
99 L.A. may order paving of courts and alleys.
100 And compel owners to keep them in repair.
116 Watering of streets.
118 L.A. may appoint and pay crossing-sweepers.
135 Powers of M.B.W. in respect of main sewers.
137 M.B.W. may declare any sewer to be a main sewer.
138 M.B.W. to control construction of sewers by L.A.
204 No buildings to be erected over sewers without consent of M.B.W. or L.A.
205 Rubbish not to be passed into sewer.
208 General provisions as to power of entry.
209 Penalties for obstructing execution of Act.
211 Appeals to P.S.
212 Appeals to M.B.W.
216 Payment of expenses by owners over a term of years.

M.L.M.A., 1862.

44 Construction of sewers by owners of land.
45 Plans to be submitted by L.A. to M.B.W.
46 Notice by L.A. to M.B.W. of intended connections with main sewer.
47 Consent of L.A. to connection of drain with sewer.
48 Consent of M.B.W. to connection of sewer with main sewer.
49 Plans to be deposited in such cases.
50 Plans approved by M.B.W. not to be abandoned or altered without their consent.
51 If not begun within a year, fresh application required.
52 Apportionment of cost of new sewers among owners.
53 When owners have paid sewers rate before provision of sewers L.A. may take part of cost.
54 Lands may be charged less than houses.
55 Procedure when cost has been over or under estimated.
56 Power of L.A. to defray any expenses out of rates.
57 Appeal to M.B.W. by persons aggrieved by L.A.
58 Procedure when sewerage works have to be extended beyond area of metropolis.
59 Application of § 80 of M.L.M.A., 1855, to sewers in general.
61 Penalties for illegal construction or connection of drains.
64 Penalty for neglect or refusal to carry out works ordered by L.A.
65 Penalty by causing such offence by another.
66 Temporary permission of cesspit where no sewer accessible.
68 Penalty for obstructing or endangering sewer by building or otherwise.
83 Bye-laws and regulations by M.B.W. for guidance of L.A.

N.B. These clauses contain the whole law of sewers and drains in London, on which the P.H.(L.)A., 1891, is silent. For the provinces see P.H.A., 1875, §§ 13—34.

PUBLIC HEALTH (LONDON) ACT, 1891.

Sec. 1. It shall be the duty of every S.A. to cause to be made from time to time inspections of their district for the detection and abatement of nuisances, and otherwise enforcing their powers.

Sec. 2. Nuisances to be summarily dealt with are defined to be (*a*) any premises; (*b*) ditch, cistern, closet, privy, urinal, cesspool, drain, dung-pit, &c.; (*c*) accumulation or deposit in such a state, or (*d*) animal so kept, or (*e*) house or part of a house so overcrowded, whether by members of the same family or not, as to be dangerous or injurious to health; also (*f*) the absence of water fittings required by Sec. 33 of the M.W.A., 1871, and any factory or workshop not subject to F.W.A. 1878, which is (1) not kept clean, free from effluvia, &c.; (2) not ventilated so as to render gases, vapours, dust, &c. produced therein so far as practicable harmless, or (3) is dangerously overcrowded.

Provided that (1) an accumulation or deposit necessary for carrying on the business shall not be deemed a nuisance, if it be proved to the satisfaction of the court that it is not kept longer than is necessary, and that the best available means are taken to prevent injury to health therefrom; (2) when the same premises are used both as dwelling-house and factory or workshop, in any decision as to the overcrowding of either, the other user shall be taken into account.

Sec. 3. *Any person* may give information to the S.A. of a nuisance, and it shall be the *duty* of every officer of the L.A., and relieving officer so to do and to give written notice to the persons who may be required to abate it.

Sec. 4. The S.A. shall, if satisfied of the existence of a nuisance, serve on the person answerable therefor an order for its abatement within a specified time, and may require him to do what is necessary to prevent its recurrence, and in either case may specify the works to be executed for the purpose. If such person cannot be found, the order shall be served on the O. or O., unless it is clear that they are not answerable, when the S.A. may abate it and do what is necessary to prevent its recurrence.

If the premises are unoccupied, or if the nuisance arise from structural defects, the notices shall be served on the *owner only*. When the M.O.H. certifies to overcrowding (Sec. 2, sub. 1 *e*), the S.A. *shall* take proceedings for its abatement: when the nuisance is want of water (Sec. 2, sub. 1 *f*, or M.W.A. 1871, s. 33), the house shall be deemed *U.H.H.* unless, and until, the court be satisfied to the contrary. (4) And if the cause of the nuisance be clearly wilful, or a notice having been served on any person he fail to comply, he shall be liable to a fine < £10 for each offence, whether a N.O. have been made or not.

Sec. 5, 1. (*a*) In case of default or (*b*) in the prospect of the recurrence of the nuisance, though for the time abated, the S.A. may complain to the P.S.C., which may then make a summary order, called a N.O. (2) A N.O. may be for abatement, prohibition or closure, or a combination of such orders. (3) An A.O. may require compliance with the requirements of the notice, or others within a specified time. (4) An A.O. or P.O. shall, if the person require, or the court think fit, specify the work to be done. (5) A P.O. may prohibit the recurrence of the nuisance, and (6) a C.O., the use of the house for human habitation, but (7) shall be made only when the court is satisfied that it is *U.H.H.*, when a fine < £20 may be imposed. (8) When satisfied that the house has been rendered fit, the court may cancel the C.O. (9) A person failing to comply with the requirements shall, unless he satisfy the court that he had used "all due diligence" to carry them out, be liable to a fine < £1 a day during default; and one knowingly and wilfully disobeying a P.O. or C.O. to a fine < 40*s*. a day, and the S.A. may enter, abate the nuisance, and execute the order.

Sec. 6. (1) Pending appeal to C.Q.S., no proceedings shall be taken or work done under the order, save that (2) no appeal shall lie except against P.O., C.O., or N.O. requiring execution of *structural* works. (3) The appeal being abandoned or dismissed, appellant becomes liable to a D.P. < £1, which the C.Q.S. may impose as if it were a C.P.S. or C.S.J., unless he prove "substantial grounds" for appeal and not mere purpose of delay. (4) If the court making the order be of opinion that the continuance of the nuisance pending appeal will be dangerous or injurious to health, and that its abatement will not cause any injury that cannot be compensated by damages, it may authorize S.A. to abate it. If appeal be successful, S.A. must pay cost of abatement, and compensation (if any), otherwise the costs may be summarily recovered from appellant.

Sec. 7. In the case of two convictions for overcrowding within three months, whether the parties be the same or not, the court may, on application of S.A., order the house to be closed so long as it see fit.

Sec. 8. If the court be satisfied that the person in fault is not known and cannot be found, the order may be addressed to S.A., to be carried out by them.

Sec. 9. S.A. may sell or otherwise dispose of any matter or thing removed by them in abating, &c., the nuisance, appropriating the same in payment of expenses, and paying the balance (if any) on demand to the owner.

Sec. 10. S.A. may from time to time enter any premises (*a*) to ascertain the existence of any nuisance at any hour of the day, or at any hour when any business is usually carried on;

(*b*) after notice or order made at any such hour until nuisance is abated or works ordered are done, and (*c*) in case of non-compliance, for the purpose of executing the same.

Sec. 11. All reasonable costs and expenses incurred in notice, complaint, or orders may be recovered by S.A. from person on whom the order is made, or if made on S.A., or if no order is made but nuisance be proved, from the person causing the nuisance; and if he be not the owner, then from any one who may be the owner for the time being, in the County Court or High Court, and the court may divide costs, fines, &c., among any persons answerable for the nuisance as it thinks just.

Sec. 12. (1) Complaint of a nuisance may be made by *any person*, and the like proceedings follow as if it had been made by S.A. (2) Provided that the court may, if it see fit, adjourn the hearing for the purpose of examining the premises, and may (*a*) authorize a constable or other person to enter such premises to determine whether a nuisance exists, or (*b*) to carry out an order, and to summarily recover expenses, (3) such constable or other person to have powers and duties of officer of S.A.

Sec. 13. The S.A. may, if in their opinion the ordinary summary procedure would be inadequate, take proceedings in the High Court.

Sec. 14. (1) If a nuisance affecting persons within their district be caused wholly or in part by the act, default, &c., of persons without the same, the S.A. may take proceedings against the offenders, but in a court having jurisdiction in the district where the nuisance originates. (2) Sec. 108 of P.H.A. 1875, shall for this purpose extend to London with substitution of S.A.

Sec. 15. The penalty for wilfully damaging any drain, w.c., &c., or apparatus connected therewith so as to make it a nuisance, shall be a fine $<$ £5.

Sec. 16. (1) Every S.A. *shall* make B.L. (*a*) for prevention of nuisances arising from snow, dust, rubbish, offal, filth, &c., or other matter or thing in the streets; or (*b*) from any offensive matter running out of any factory, brewery, slaughter-house, shop, dung-hill, &c., into any uncovered place whether enclosed by walls or not; (*c*) for preventing the keeping of any animal so as to be a nuisance; and (*d*) for the paving of yards, &c., in connection with dwelling-houses. (2) The L.C.C. *shall* make bye-laws (*a*) for prescribing the times and vehicles for the removal by road or water of any offensive or noxious matter or liquid in or through London, and (*b*) as to the closing and filling up of c.p. and p.s., and the duties of occupiers in connection with house refuse and its removal by the S.A. (3) It shall be the duty of the S.A. to observe and enforce these B.L. (4) A constable may arrest and take before a J. P. any person offending against these bye-laws, who refuses to give his true name and address, (5) provided that it shall not be an offence to lay or use any litter to prevent freezing of water-pipes, or the noise of vehicles in case of sickness if only the same be removed when no longer needed.

Sec. 17. Any one keeping or feeding swine in any unfit place, or where a nuisance may arise therefrom, or within forty yards of any street or public place, or permitting them to go about such street, &c., shall be liable to a fine < £2, and to forfeit the same, which if found straying may be seized and removed by any constable, and to a further D.P. < 10*s*. while he continues the offence after notice from S.A.

Sec. 18. A P.S.C. may, by summary order, prohibit the use of any place for keeping any animal, which it deems unfit.

Offensive Trades.

Sec. 19. (1) A person establishing anew the business of (*a*) manure manufacturer, blood, bone, tallow or soap-boiler, or knacker, or (*b*) without the consent of C.C. those of fellmonger, tripe-boiler, horse or cattle slaughterer, or soap-boiler (2) using no animal fat or oil other than oleine for admixture with soda, shall be liable to a fine < £50 for the fact, and the same D.P. (8) Establishment anew includes, reopening after discontinuance of work for nine months, removal to new premises or extension of existing buildings, but not reconstruction, partial or complete, without extension of area. (3) Sanction of C.C. must be by order, for which a fee < £2 may be charged in aid of county fund; but must be preceded by at least fourteen days' notice to S.A., a copy of which must be conspicuously affixed to the premises, and by advt. when and where objections to the application will be considered. (4) C.C. may make B.L. as to arrangement of premises and conduct of such businesses which (5) may empower a P.S.C. to prohibit any person from following the same temporarily or permanently: as a penalty for breaking such B.L., with a D.P. < £50, but any S.A. or person aggrieved by the enactment, alteration, or repeal of any such bye-law, may give notice to the L.G.B. (9) The Metropolitan and Deptford cattle markets are exempted, and (10) in the city the Commissioners of Sewers take place of C.C.

Sec. 20. No person shall carry on the business of cow-keeper, slaughterer, or knacker, except in premises annually licensed for the purpose by C.C., under a penalty < £5 for each offence, of which the taking of cattle into unlicensed premises shall be *primâ facie* evidence. (2) Such licenses, for which C.C. may charge 5*s*., payable to county fund, shall expire on such day in each year as the C.C. may fix, or in the case of a license first granted, on the second such day following. (3) Fourteen days' notice of intention to apply for grant or renewal of a license must be given to the S.A., that they may if they think fit object. (4) Objections to renewal must be served on applicant seven days before, but the C.C. may, on receiving later objection, adjourn the hearing and renewal to another day. (5) When a committee of the C.C. recommend refusal of renewal, the C.C. shall, seven days after the applicant has been informed thereof, hear him against such refusal. (6) A further license granted in immediate succession to a prior one for the same premises shall be deemed a renewal of the former. (7) S.A. may enter any slaughter-house or knacker's yard at any hour when the business is usually carried on. (8) This section does not apply to the Metropolitan Cattle Market.

Sec. 21. If the M.O.H., or two M.M., or ten inhabitants of a district, certify to the S.A. that the effluvia from any manufacture are injurious or dangerous to the health of the inhabitants, the S.A. shall make complaint to P.S.C., and the court, if satisfied thereof and that the best possible means have not been used for abating or preventing the nuisance, may impose on the owner, occupier, or foreman so offending a fine $<$ £50 ; but (2) they may suspend their determination on his undertaking to adopt within a reasonable time such means for avoiding the nuisance as the court may deem practicable. (3) The S.A. may, if they prefer, take these proceedings in the High Court instead of the P.S.C. (4) If the said nuisance arise without their district, the S.A. may take like proceedings, but in a court having jurisdiction in the district where the premises are situate. (5) Sec. 115 P.H.A. shall extend to London with substitution of proper S.A.

Sec. 22. The removal, storage, and disposal of house and street refuse by the S.A. shall be deemed a business carried on by them, and in respect of any nuisance arising therefrom complaints may be made to, and proceedings taken by, the C.C. as if it were a S.A.

Smoke Consumption.

Sec. 23. Every furnace, whether connected with a steam-engine or not, in any buildings used for trade or manufacture, public or private, including gas and water-works and public baths and wash-houses, shall consume its own smoke. (2) An owner, occupier, or foreman (*a*) using a furnace not so constructed, or (*b*) negligently so as not to effect the consumption, or (*c*) carrying on any trade or business giving off effluvia or otherwise "annoying" the neighbourhood, without using the best practicable means for avoiding the nuisance, shall be liable on the first conviction to a fine $<$ £5, on a second to a fine of £10, and on each subsequent conviction to a fine double that preceding. (3) The same shall apply to all steam vessels on the Thames. (4) The total consumption of the smoke is not in all cases to be required, but as much as can reasonably be expected. (5) Proceedings under this section may be taken only by the S.A., whose duty it shall be to enforce it, and for that purpose (6) they shall have the rights of entry and other powers enjoyed in the case of general nuisances. (7) In the port of London the duty shall devolve on the P.S.A. (8) Nothing in this Act shall alter or repeal the provisions of the City of London Sewers Act, 1851, or of the Whitechapel Improvement Act, 1853.

Sec. 24. Furnaces not complying with the preceding section, or chimneys other than those in private dwelling-houses, emitting black smoke (L.C.C. recognize as such three of those in Donkin's scale), shall be nuisances liable to be dealt with summarily.

Workshops and Bakehouses.

Sec. 25. When M.O.H. deems the cleansing, &c., of any workshop or place, other than a bakehouse, necessary for the health of the workpeople, S.A. shall serve notice to that effect, on the O. or *O.*, who, if he fail to do the work within the time specified, shall be liable to a penalty $>$ £5 and D.P. 10*s.* Another S.A. may do the work, summarily recovering their expenses. This section applies to any factory not under F.W.A., 1878, &c., &c.

Sec. 26. Secs. 34, 35, and 81 of F.W.A., 1878, and Secs. 15 & 16 of F.W.(A.)A., 1883, shall apply to every bakehouse which is a workshop, and be enforced by the local S.A. (2) Provisions respecting right of entry by, and obstruction of S.A. in regard to nuisances, apply equally to this section.

Sec. 27. If M.O.H. find women or children employed in such workshops, he shall inform the Factory Inspector of the district thereof in writing.

Dairies.

Sec. 28. (1) L.G.B. may make orders for (*a*) registration with C.C. of *persons* carrying on the trade of dairymen, [Sec. 20 deals with the premises only] (*b*) for inspecting the animals and regulating the general sanitary arrangements of water supply of dairies, occupied by dairymen ; (*c*) for securing the cleanliness of churns and other vessels ; (*d*) for protecting milk from infection ; and (*e*) authorizing C.C. to make such bye-laws. (2) The C.C. and (*f*) in the City the Common Council shall enjoy for this purpose the powers, right of entry, &c., possessed by the S.A. in the case of general nuisances; and (3) the L.G.B. may in such orders impose like fines.

Removal of Refuse.

Sec. 29. (1) The S.A. must remove all refuse, &c., and keep clean all public streets and ways *including footpaths*, and (2) so much of any Act as imposes the duty of cleansing footpaths on the occupiers and owners is hereby repealed. (3) Default on the part of the S.A. or of their contractors to do this, so far as practicable, shall render them liable to a fine < £20.

Sec. 30. (*a*) The S.A. must also, at regular periods duly published, remove all house refuse, and clean all a.p., p., c.p., &c. ; and (*b*) if they neglect to do so at the proper period, shall within forty-eight hours (exclusive of Sundays and holidays) after receiving written notice from the occupier, and (2) failing to do so, shall be liable to a like fine. (3) Any person in the employment of the S.A. or of their contractors, demanding a gratuity for his services, shall be liable to a fine < £1.

Sec. 31. Every S.A. shall employ, or contract with a sufficient number of scavengers for the regular and efficient carrying out of these provisions.

Sec. 32. All such refuse, &c., shall be the property of the S.A., which they may dispose of or sell as they think fit, for defraying their expenses under this Act.

Sec. 33. (1) The S.A., if requested, must also remove any *trade* refuse, but may demand a reasonable payment for so doing, and any dispute between the S.A. and the O. or *O.* as to such charge, or (2) as to what is or is not *trade* refuse, shall, on complaint of either party, be determined by a P.S.C., such decision being final.

Sec. 34. No one, save the S.A., their servants or contractors, may collect, remove, or receive any house refuse under a penalty < £5, unless the S.A. have neglected to do so for seven days, when, after twenty-four hours' notice to S.A., the occupier of the premises may sell it or give it away.

Sec. 35. When it appears to a S.I. that any noxious matter, which it is not the duty of the S.A. to remove, ought to be removed, he shall serve a notice on the occupier, and if he have not removed it within forty-eight hours, exclusive of Sundays, &c., it shall become the property of, and be removed by the S.A. as house refuse. The S.A. may recover summarily the cost of such removal, so far as not covered by its sale, from the occupier, or if there be none, from the owner of the premises, but if there be a surplus from the sale, it shall be paid on demand to the former owner of the matter.

Sec. 36. The S.A. may employ, or contract with a sufficient number of scavengers, for the collection and removal of stable and cow-house refuse, with the written consent of the occupiers, but (*a*) this consent shall not be withdrawn without one month's notice; and (*b*) no person shall be hereby relieved from any fine for placing dung, &c., on footways and carriage ways, or for having accumulations thereof, such as to be a nuisance. (2) S.A. may give public notice requiring periodical removal of stable and cow-house manure, for non-compliance with which the owner thereof shall be liable, without further notice, to a D.P. $<$ £1.

Regulations as to Water-closets, &c.

Sec. 37. It shall not be lawful to erect or rebuild any house without a proper covered a.p., and one or more w.c.'s, as circumstances may require, with suitable water supply and fittings, trapped soil-pan, &c., (2) under a penalty $<$ £20. (3) If any house, built before or after the passing of this Act, be found to be not so provided, the S.A. shall serve on the O. or *O.* a notice warning him to provide the same within a time named therein, under a penalty $<$ £5 and D.P. £2; or the S.A. may instead enter and execute the work, recovering the cost from the owner. (4) Provided that (*a*) where the sewerage or the water supply is insufficient for a w.c., a privy or an e.c. may be substituted, and (*b*) where before the date of this Act a w.c. has been, and in the opinion of the S.A. may continue to be, used by inmates of more than one house, they need not require one to each. (5) Appeals from any notice or act of S.A. under this section, to be made to C.C., whose decision shall be final.

Sec. 38. (1) Every factory, workshop, &c., erected before or since this Act, shall be provided with s.c., suitable and sufficient for the number of persons employed, and for the sexes separately. (2) In case of non-compliance, the S.A. shall serve on the O. or *O.* notice to make the necessary alterations or additions, and failing so to do, he shall be liable to a fine $<$ £20, and D.P. £2 after conviction.

Sec. 39. (1) The C.C. *shall* make B.L. with respect to all w.c., c.p., p., a.p., d.p., and their accessories, whether constructed before or since this Act; (2) and every S.A. with respect to the water supply to closets, (3) which must be in accordance with those of C.C., and S.A. shall observe and enforce the same.

Sec. 40. The S.A. may enter any premises after twenty-four hours' notice to the occupier, or, if there be none, to the owner, and in cases of emergency without notice, at all reasonable times by day to examine any w.c., p., c.p., a.p., d.p., drains, pipes, traps, &c., connected therewith, and may cause the ground to be opened if necessary, with as little damage as possible. (2) If the work be found to be in accordance with this Act and any B.L., they shall at once reinstate the same at their own cost and pay full compensation for any damage sustained, but if not in proper condition and order they may recover their reasonable expenses in a summary manner.

Sec. 41. (1) (*a*) If not in accordance with this Act or any bye-laws, or (*b*) if they have been constructed or reconstructed in defiance of a D.O. or prohibition, or (*c*) the water supply have been discontinued without lawful authority, or (*d*) any such works have been destroyed illegally or so as to create a nuisance or a danger to health, the person so offending shall be liable to a fine < £10; and if he do not within fourteen days from receiving the notice, or such further time as may be allowed by the S.A. or a P.S.C., repair, restore, remove, or otherwise remedy the defect, to a D.P. < £1, or the S.A. may in lieu of proceeding enter and execute the work at the cost of the offender. (2) If on such examination any of the aforesaid structures or apparatus appear to be in bad condition, and to need alteration, repair, or cleaning, the S.A. shall serve on the occupier a notice requiring him to do what is necessary within a specified time, failing which he shall be liable to a fine < £5, and a D.P. £2, or the S.A. may enter, and execute the work at his expense, but he (3) may appeal to the C.C., whose decision shall be final.

Sec. 42. If any w.c. or drain be so improperly constructed or repaired as to be a nuisance or dangerous to health, the person answerable for the work shall be liable to a fine < £20. Provided that if he can prove to the court that he had used due diligence, and some person employed by him, whom he shall be entitled to bring before the court, be the offender, he shall be exempt and the other may be summarily convicted.

Sec. 43. (1) (*a*) Every S.A. shall drain, cleanse, cover, or fill up, or cause to be so done, all ponds, ditches, &c., collecting any water, filth, or other matter likely to be an offence, or nuisance, or danger to health, and (*b*) shall cause notice to be served on the O. or *O.* of any premises where such exist, to do what may be required for the purposes, (2) and failing to comply he shall be liable to a fine < £5, with D.P. < £2, or the S.A. may enter, do the work and recover their expenses from him, but they may, if they think reasonable, defray the whole or a part of the cost, as in the case of sewerage works. If any such act of the S.A. injuriously affect any ancient mill or other rights to the use of the water, the S.A. shall make full compensation for the damage, or buy up such mill or water rights, as provided by M.M.A., 1885. (3) Any one aggrieved by such notice or act may appeal to the C.C., whose decision shall be final.

Sec. 44. Every S.A. may provide public closets, urinals, lavatories, and a.p.s, and supply the same with water, defraying the cost of construction and maintenance, and of compensation to persons whose property is injured thereby, as if they were expenses of sewerage; for this purpose the subsoil of any road, except that of footways adjoining any buildings, or of the curtilage, shall be vested in S.A.

Sec. 45. (1) In such case the S.A. may (*a*) make regulations for management and use of the same, (*b*) charge for use, or (*c*) let them subject to any conditions and rent for terms not exceeding three years. (2) Any person erecting a s.c. or a.p. in contravention of this section, and not removing it when required to do so by the S.A., shall be liable to a fine < £5, and D.P. £1 after conviction. (4) Nothing in this section shall apply to railway stations.

Sec. 46. Wilful damage to or improper fouling of any s.c. used by occupiers of more than one dwelling-house involves a fine < 10*s*., and if in opinion of S.A., S.I., or M.O.H., any such is in such a state as to be a nuisance, or "annoyance" for want of cleansing, the persons in default, or in the absence of evidence as to which, each of those using it in common, shall be liable to a fine < 10*s*. with D.P. 5*s*. after conviction.

Unsound Food.

Sec. 47. (1) Any M.O.H. or S.I. may at all reasonable times enter any premises to inspect and examine any (*a*) animal or "any (*b*) article, solid or liquid, intended for the food of man and sold, or exposed for sale, or deposited in any place for the purpose of sale or preparation for sale," proof that it was not so exposed or deposited resting with person charged; and if he find it "diseased, unsound, unwholesome, or unfit for food of man," may seize or cause it to be seized to be dealt with by a magistrate. (2) And if the J.P. find it thus unfit, he shall condemn the same and order it to be destroyed or so disposed of as to be unsaleable for food, and the person offending shall be liable on summary conviction to a fine < £50 for each animal, article, or parcel condemned, or at the discretion of the court without fine to imprisonment < 6 months with or without hard labour. (3) When it is found that it was in such state when sold to the accused, the original vendor shall be liable to like penalties unless he can prove that he did not know or have reason to believe that it was so unfit. (4) In the case of two convictions for such offence knowingly and wilfully committed within twelve months, the court may order a notice to that effect to be exposed < 21 days in a conspicuous part of the premises, and any person obstructing the affixing or concealing or defacing the notice shall be liable for each offence to a fine < £5. (5) One conviction shall render the occupier of a slaughter-house liable to forfeiture of his license by the court. (6) Any one obstructing an officer acting under a warrant for entry within twelve months after a previous conviction for obstruction, or evidently with intent to prevent detection shall be liable to imprisonment < 1 month in lieu of fine, at the discretion of a (7) J.P. whether the same as he who condemned the food or not. (8) Any one having in his possession food unsound and unfit for man may inform the S.A. thereof in writing, and request its removal as trade refuse by the S.A.

Provisions as to Water.

Sec. 48. No house, built or rebuilt, after this Act shall be occupied until it is certified by S.A. to have a "proper and sufficient water-supply." If the S.A. refuse or fail to grant such certificate within one month after request from the owner, he may appeal to P.S.C. Any house whatever occupied without proper water-supply and any new one since the passing of this act shall be deemed a nuisance, and if a "dwelling-house," *U.H.H.*, and any person letting such house or allowing it to be so occupied shall be liable to a fine $<$ £10, and D.P. 10*s.* during occupation without proper water supply, without prejudice to proceedings for C.O.

Sec. 49. Any water company exercising its legal right to cut off the water supply of an occupied house for non-payment of water-rate, shall within twenty-four hours notify the same to the S.A. under a penalty $<$ £10, and in all cases of default S.A. *must* proceed.

Sec. 50. Every S.A. shall make B.L. for cleansing and protecting all cisterns, &c., used for storing water for domestic purposes, drinking, or manufacture of beverages.

Sec. 51. All public reservoirs, pumps, wells, fountains, &c., used for gratuitous supply of water, and not being private property, shall be visited in and under control of S.A., who may maintain, improve, or close these, and provide others in addition or substitution, and any person wilfully damaging any such pump, drinking-fountains, &c., shall be liable in addition to any fine, to pay to S.A. the cost of reinstating the same.

Sec. 52. (1) Any person who in the manufacture of gas wilfully or negligently causes, or suffers any substance or washings produced in the preparation or supply of gas to gain access to any source or supply of water, shall be liable to a fine of £200 for every such offence, and after twenty-four hours' notice from the S.A. or the person to whom the water belongs, a D.P. of £20, (2) to be recovered with full costs in the High Court by the persons to whom the water belongs, or by the S.A. if the water be under their control, or when the person whose water is fouled fails to proceed and they have given him notice of their intention so to do, provided always such proceedings be taken within six months after the cessation of the offence.

Sec. 53. Any one wilfully damaging any pump or fountain, or fouling, otherwise than as in last Sec., any such source of water for drinking, shall be liable to a fine < £5 and D.P. of £1 after service of notice.

Sec. 54. On the complaint to the S.A. of *any person* that the water of any well, pump, tank, &c., public or private, is or is likely to be injurious or dangerous to the health of persons using it, a P.S.C. after receiving complaint of S.A. and hearing evidence of the O. or *O.* of the premises if it be a private well, or of the persons interested therein if a public one, or after giving them the opportunity of being heard, may direct it to be permanently or temporarily closed, or make such order as may prevent further danger from its use, (2) and may cause analysis of the water to be made at the expense of the S.A. (3) If the person on whom the order is made fail to comply, he shall be liable to a fine < £20, and the P.S.C. may on complaint from S.A. authorise S.A. to execute the order at his expense.

INFECTIOUS DISEASES.—*Notification.*

Sec. 55. (1) When any person is suffering from an *I.D.* (*a*) the head of the family or the nearest relatives or any person in attendance on or in charge of the patient, or the master of the house, *shall*, so soon as aware of the nature of the illness, send notice therof to the M.O.H. (*b*) Every M.M. attending on or called to the patient shall in like manner send a certificate stating full name, age, and sex of the patient, the full postal address of the house, and the nature of the disease; also whether in his private or official practice, and if in a hospital the place from which and the date when the patient was admitted, to the M.O.H. of the district in which the place is situate; except that in the case of the hospitals of the M.A.B. such notice need not be sent in respect of patients admitted on a copy of the certificate previously forwarded by a M.M. to the M.O.H. (2) Any person failing to notify is liable to a fine < £2, unless in the case of persons not liable in the first instance they show that they had good reason to believe that notice had been duly sent. (3) The L.G.B. may prescribe forms which shall then be always used, and the S.A. shall furnish forms gratuitously on application to any M.M. in their district, and pay him 2*s.* 6*d.* for each certificate of cases occurring in his private practice, and 1*s.* of those in his official practice. (4) The M.O.H. shall within twelve hours send a copy of each certificate to the M.A.M. and to the Head Teacher of the school at which the patient (if a child) or any child living in the same house, attends. The M.A.M. shall refund to the S.A. fees paid by them in respect of cases thus admitted, and shall send to the C.C. and to every M.O.H., weekly returns of admissions to their hospitals; and (5) where there are two or more M.O.H.'s in a district, certificates shall be sent to each of cases occurring in his own division or to such officer as the S.A. may direct, (6) at his house or office. (7) Every inhabited building, vessel, shed, tent, or van shall be deemed a house for the purposes of this section, but it shall not apply to any house, vessel, &c., belonging to Her Majesty, or to any vessel belonging to a foreign Government. (8) "Infectious disease" here means smallpox, cholera, dipththeria, and membranous croup, erysipelas, scarlatina, typhus, typhoid, or enteric, relapsing, puerperal and "continued" fevers, and any other disease which in any district may be declared notifiable.

Sec. 56. (1) A S.A. may by resolution passed (2) at a meeting of which fourteen days' special notice has been given to each member, add, either permanently or for a specified period, to the above any other *I.D.*, and such order may be in like manner revoked or varied. (3) Such order shall not be valid until it be approved by the L.G.B., which the S.A. shall announce by advt. and handbills, and by notice to every M.M. in their district, and (4) it shall come in force at such date not less than one week after publication, as shall be stated in the advt., &c. (5) In case of emergency three clear days' notice of the meeting and the order may suffice, if a copy of the resolution be sent to and the order approved by the L.G.B. Such order shall come into operation one week from the advt., and, unless the L.G.B. rule otherwise, shall cease at the expiration of one month, or earlier if L.G.B. so direct. (6) The L.C.C. shall have the same power of including other diseases over the whole county, and of varying and revoking such orders as each S.A. has in respect of its district.

Sec. 57. Payment for notification shall not disqualify a M.M. from being a member of a L.B. and when he is himself the M.O.H. he shall be equally entitled to the fees.

INFECTIOUS DISEASES.—*Prevention.*

Sec. 58. The following provisions shall apply to the *I.D.* in the schedule [sec. 55 (8)] and to any others wherever and so long as they may be included in or added to the same.

Sec. 59. (1) Every S.A. shall provide either within or without their district, or (2) may combine or contract with another to provide, proper premises and apparatus with attendants, for the conveyance, disinfection, and destruction if necessary, of bedding, clothing, &c., infected by the above or by other *I. D.*, and may remove, destroy, or disinfect and return such free of charge.

Sec. 60. When the M.O.H. or any M.M. certifies that the cleansing and disinfecting of a house, rooms, or articles therein, or the destruction of such articles, would tend to prevent the spread of *I.D.*, the S.A. shall serve on the master, or, if unoccupied, on the owner, notice of their intention to carry out such disinfecting, &c., within a specified time, unless he within twenty-four hours undertake to do the same to the satisfaction of the M.O.H. or M.M. If he consent, or fail to promise within twenty-four hours, or having promised, fail to perform the work, it shall be done by and at the expense of the S.A. under the superintendence of the M.O.H., and for this purpose the S.A. (3) may enter premises at any hour of the day. (4) The S.A. shall provide free temporary accommodation, with necessary attendance for persons compelled to leave their dwellings during disinfection, (5) and shall compensate the owners for any damage done or articles destroyed.

Sec. 61. (1) Any S.A. may serve on the owner of any infected bedding, clothing, &c., notice to deliver them to their officers for disinfection or destruction, and failing to comply he shall be liable to a fine < £10. (2) The articles when disinfected shall be returned free of charge, and the S.A. shall compensate the owner for unnecessary damage, and for any articles destroyed, such compensation to be summarily recoverable.

Sec. 62. Any one knowingly throwing or permitting to be thrown any infectious things or matters into an *a.p.* without previous disinfection shall be liable to a fine < £5, and a D.P. of £2 after due notice, which the S.A. shall give to the master of every house in which they know that there has been a case of *I.D.*, offering to remove and destroy or disinfect such things free.

Sec. 63. (1) Any person who knowingly lets for hire a house or rooms in which there has been a case of *D.I.D.* without having had the same disinfected to the satisfaction of a M.M., certified in writing, and all articles therein capable of retaining infection so disinfected or destroyed, shall be liable to a fine < £20. This applies also to keepers of hotels and inns.

Sec. 64. Any person who with a view to letting a house or rooms shall deny that there has been any *D.I.D.* therein within six weeks preceding, knowing such declaration to be false, shall be liable to a fine < £20, or to imprisonment < one month with or without hard labour.

Sec. 65. (1) Any one ceasing to occupy a house or part of a house in which there has been within six weeks preceding a case of *D.I.D.*, without (*a*) having had the same disinfected as aforesaid, or (*b*) informing the owner or master, or (*c*) making a false declaration as to the fact, shall be liable to a fine < £10. (2) S.A. shall service notice of these provisions on the master of every house in which they know such disease to exist.

Sec. 66. Any person suffering from *D.I.D.* who is "without proper lodging or accommodation," or is in a tent or van, or on board a vessel, may on a medical certificate be removed by order of J.P. and at the cost of the S.A. to any hospital at a convenient distance, with the consent of the managers thereof. (2) The order may be addressed to such constable or officer of the S.A. as the J.P. thinks fit, and any person disobeying or obstructing shall be liable to a fine < £10. (3) A S.A. may make B.L. for the removal to, and detention so long as needful in such hospital, of persons suffering from a *D.I.D.* brought in any vessel within their district. [Why in *vessels* only ?]

Sec. 67. A J.P. may order the detention in hospital at cost of M.A.M. of any person suffering from *D.I.D.* who *on leaving* will not have "proper lodging and accommodation," and may extend the time as he thinks necessary for preventing infection. The order may be carried out by any officer of the S.A. or of the M.A.M. or inspector of police or officer of hospital.

Sec. 68. (1) If any person (*a*) while suffering from a *D.I.D.* wilfully and without proper precaution expose himself, or (*b*) being in charge of such person expose him in any street or place or house of public resort, or any public vehicle, or (*c*) give, sell, or otherwise dispose of any articles that have been exposed to infection without previous sufficient disinfection, (2) except in the removal of such under proper precautions for destruction or disinfection, he shall be liable to a fine < £5.

Sec. 69. A person knowing himself to be suffering from a *D.I.D.* who milks a cow, or in any way handles food or engages in any occupation in such a way as to be likely to spread infection, shall be liable to a fine < £10.

Sec. 70. A person who suffering from *D.I.D.* travels in any public conveyance, or who causes one so suffering to do so, and the owner or driver who knowingly so carries such persons, shall be liable to a fine < £10. An owner or driver having so done shall, under a penalty < £5, report the fact at once to the S.A., and shall cause his vehicle to be disinfected, either by the S.A. or otherwise. The S.A. *shall* provide for such disinfection, and *may* do it free of cost; and the owner or driver may recover summarily from such person his expenses and compensation for loss sustained thereby.

Sec. 71. (1) If the M.O.H. find that any person *in his district* is suffering from *D.I.D.*, attributable to milk from a dairy *in or out of* his district, or that the milk from such dairy is *likely to cause* such disease to persons *in his district*, he shall obtain an order from a J.P. in the district where the dairy is situate to inspect it, and if accompanied by a M.R.C.V.S. to inspect the animals, and if satisfied that the consumption of milk therefrom is [likely to be ?] the cause of *D.I.D.*, he shall report to the S.A., appending the report of the V.S., and the S.A. *may* serve on the keeper of the dairy notice to appear before them within not less than 24 hours to show cause why an order should not be made on him not to supply milk *within* *the district*[1] until the order be withdrawn. (2) The S.A., if they make such order, shall serve notice of the facts on the L.G.B., the C.C. of the county, and if the dairy be in another S.D. on the S.A. of that district, (3) but the order shall be withdrawn so soon as the S.A. or their M.O.H. is satisfied that the supply has been changed or the danger been removed. (4) Any person obstructing the inspection or supplying such milk contrary to the order shall be liable to a fine < £5, and a D.P. < £2, (5) provided that proceedings shall be taken before a court having jurisdiction in the district in which the dairy is situate, and that the dairyman shall not be liable for any breach of contract caused by such order, (6) and if the dairy be in a district under the P.H.A. [*i. e.* out of London], the procedure shall be the same. (7) Nothing in this section shall interfere with anything under the C.D.(A.)A., or any order, licence, or Act of the L.G.B., or Board of Agriculture, or any B.L., &c., of L.A., made under any of the foregoing.

Sec. 72. No one shall without written sanction of M.O.H. or a M.M. retain the body of a person dying of *D.I.D.* for more than 48 hours in any dwelling, sleeping, or work-place under a penalty < £5.

Sec. 73. If the M.O.H. or a M.M. certify that the removal of the body of a person dying of *D.I.D.* in a hospital would involve risk of infection, it shall not be removed thence except for burial or to a mortuary under a penalty < £10.

Sec. 74. If a person uses any public conveyance, other than a hearse, for the removal of a body of one dying of *D.I.D.* without previously informing the owner, and if the owner or driver do not immediately thereafter provide for the disinfection of the vehicle, he shall be liable to a fine < £5, and a D.P. of £2.

Hospitals and Ambulances.

Sec. 75. Any S.A. may, either singly or in combination with other S.A.s, provide for the use of their district hospitals, permanent or temporary, or contract for the use of any hospital or part of such, or agree with the managers for the reception of their sick on annual or other payment.

Sec. 76. Expenses of S.A. for maintenance of any patient not a pauper, and not suffering from *D.I.D.*, shall be a debt due to S.A. by patient or those chargeable for him, but proceedings shall not be begun later than six months after his discharge from or death in hospital.

Sec. 77. S.A. may, with sanction of L.G.B., provide or contract for temporary supply of medicines and medical assistance for the poor (not paupers only) of their district.

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[1] As the law stands, he is free to send it anywhere else, and thus defeat the intention of the Act. Country dairymen will mostly send it to London.

Sec. 78. S.A. may provide and maintain suitable carriages for conveying persons suffering from any *I.D.* to the hospital, and may convey them free of charge.

Sec. 79. M.A.M. shall maintain their wharves, &c., on the Thames as hitherto, and may provide (2) and maintain ambulance carriages and vessels with all the necessary premises, appliances, and staff, and (3) allow them to be used for a reasonable charge in conveying persons suffering from *D.I.D.* to other hospitals than their own.

Sec. 80. M.A.M. subject to Rg. of L.G.B., may admit non-pauper cases of small-pox or diphtheria into their hospitals at the expense of the Board of Guardians paid out of metropolitan common poor fund, such relief not to be considered parochial relief or entail any civil disqualifications.

Sec. 81. A child sent by L.S.B. to an industrial school out of London shall in respect of the provisions relating to M.A.B. be deemed to be in London and in district of M.A.B.

Prevention of Epidemic Diseases.

Sec. 82. When L.G.B. issues orders under Sec. 134 of P.H.A., the S.A. shall execute the same, appointing medical and other officers, and doing such things as may be necessary, directing prosecutions, &c., and for this purpose shall have power to enter any premises or vessels.

Sec. 83. A poor-law M.O. performing any services under this Act on board a vessel shall be entitled to charge at this usual Poor Law rate, to be paid by the master on behalf of the owner; and another M.M. in such manner as he usually charges patients of the same class. Any dispute when the charge does not exceed £20 to be decided by P.S.C.

Sec. 84. L.G.B. may by order authorize two or more S.A. to combine for carrying out these sections.

Sec. 85. The M.A.M. shall within their district have all the powers of a S.A., and may use their property and staff for executing these powers under these sections.

Sec. 86. The managers of any hospital or asylum and, with consent of L.G.B., of any workhouse infirmary may let the same or any part thereof, and contract with any S.A. for the reception of patients suffering from cholera and choleraic diarrhœa.

Sec. 87. The expenses of a S.A. in providing any buildings for the reception of patients shall to such extent as the L.G.B. shall decide, with two-thirds of the salaries of the staff, be repaid from the metropolitan common poor fund on the precept of the L.G.B. and production of vouchers, &c.

Mortuaries.

Sec. 88. Every S.A. shall provide proper mortuaries, and may make B.L. for their management and charges for use, and may provide for interment of bodies at fixed charges.

Sec. 89. Where the body of a person dying of any *I.D.* is retained in a sleeping-room, or of a *D.I.D.*, without medical sanction in a dwelling-house or workshop, beyond 48 hours, or any body in any place so as to endanger the health of any persons, a J.P. may, on a medical certificate, order it to be removed to a mortuary and buried within a time stated; or if dead of *D.I.D.* or otherwise necessary to be buried immediately, without such removal. Unless the friends undertake the burial as ordered, the relieving officer shall, at the expense of the guardians, who may recover summarily from the persons liable. Any one obstructing the order shall be liable to a fine $<$ £5.

Sec. 90. Any S.A. may, and if required by C.C. shall, provide a *post-mortem* room at Coroner's court, mortuary, or anywhere except at a workhouse. Such examinations shall not be conducted in the mortuary itself.

Sec. 91. With approval of C.C. two or more S.A.s may combine for providing, or contract for the use of a mortuary, &c.

Sec. 92. The C.C. shall provide Coroner's Courts, and may by agreement with a S.A. erect *post-mortem* room or other buildings in connection with a mortuary.

Sec. 93. The C.C. may provide in London one or two special mortuaries for bodies not identified, whither such may be removed by Coroner's order, to await inquest and identification. (2) A S.S. may make R.'s as to (*a*) the removal of bodies thither, and payment to persons bringing them; (*b*) fees to be paid on removal and interment of bodies identified, by whom to be paid, and how to be recovered; (*c*) the disposal and interment of any bodies. (3) The C.C. may provide appliances necessary for reception and preservation of such bodies, and make Rgs., subject to the provisions aforesaid, for the management and conduct of these establishments. (4) Subject to the same provisions (*d*) any body may be removed to any such building by written order of any coroner who shall hold the inquest thereon as if such building were within his district.

Bye-laws as to Houses let in Lodgings.

Sec. 94. (1) Every S.A. *shall make and enforce* B.L. (*a*) for fixing number of persons, members of more than one family, who may occupy a house, or part of a house, and for the separation of the sexes therein; (*b*) for registration, and (*c*) inspection of such houses; (*d*) for enforcing drainage and promoting cleanliness and ventilation; (*e*) for cleansing and lime-washing at stated times, (*f*) and for taking precautions in case of any *I.D.*

(2) This section shall not apply to *common* lodging-houses under the C.L.H.A., 1851, &c.

Tents and Vans.

Sec. 95. (1) A tent, van, shed, &c., used for *H.H.* in such a state or so overcrowded as to be dangerous to health, or a nuisance, shall be a nuisance to be dealt with summarily under this Act. (2) S.A. may make B.L. for promoting the cleanliness and healthiness of such dwellings, for preventing spread of *I.D.*, and obviating nuisances. (3) When any person authorized by a S.A. or J.P. has reason to believe that any van, &c., is in such a state, or so overcrowded as to be dangerous to health, or that there is therein a case of *D.I.D.*, he may enter for the purpose of seeing if such be the case, with the powers and under the conditions applicable to like entry of premises. (4) This section shall not apply to tents, &c., erected or used by H.M. military and naval forces.

Underground Rooms.

Sec. 96. *Definition.* An underground room is any room the floor of which is more than three feet below the footway or the adjacent ground. (1) No underground room shall be let or occupied as a separate dwelling, unless (*a*) it be in no part less than 7 feet high, and at least 3 feet be above the surface of the adjoining street; but if the width of the area be not less than the height of the room, the latter need only be at least one foot above the street. The area need not exceed six feet wide. (*b*) Every outer wall have a damp-proof course, and be protected from damp if in contact with the soil. (*c*) An open area at least four feet wide, and six inches below the floor, run along the whole front of the room. (There may be steps in the area for access to the room, and over it for access to the room above, provided they be not across or over any window.) (*d*) The area and soil below the room be effectually drained, and (*e*) if the room have a hollow floor, the space below be ventilated; (*f*) all drains under room be air-tight, (*g*) and the room effectually secured against rising of effluvia or vapours; (*h*) the occupants have convenient access to a w.c. and a.p., (*i*) the room be effectually ventilated, (*j*) have a fire-place and chimney, and (*k*) one or more windows opening directly to the outer air, with total area, exclusive of sash frames, equal to one-tenth of the floor area, and one-half at least of each window can be opened to the top.

(2) Any person letting or occupying a room in contravention of these provisions shall be liable to a D.P. $<$ 20*s*.

(3) These provisions shall apply to rooms not so let or occupied before the passing of this Act (Aug. 5, 1891), and from six months after (Feb. 5, 1892), to all, provided that in the case of those previously so let or occupied the S.A. may either by general Rgs., or in particular cases, on the application of the owner, dispense with, or modify such as would involve structural alterations, if they think they can do so properly, having regard to the fitness of the rooms for habitation, the sanitary conditions, house accommodation, and character of the population, but no provisions in force before the passing of this Act may be dispensed with or modified. (4) Such dispensations and modifications may be absolute or temporary, and be revoked or varied by S.A. provided such conditions are entered on their minutes. (5) Any owner aggrieved thereby may appeal to L.G.B., who may refuse, allow, or modify these requirements; such allowance may be revoked or modified by L.G.B., but not by S.A.

(6) Two or more underground rooms occupied together, but not in conjunction with a room or rooms on other floors in the same house, shall be held to be occupied separately, and must each conform to these requirements. (7) Passing the night in such a room shall be considered as occupation, and evidence giving "probable presumption" of such occupation shall be sufficient until the contrary is proved, (8) the onus lying on the defendant.

Sec. 97. (1) Any officer of S.A. appointed or deputed for the purpose, shall without fee report to the S.A. in such form, and as they may direct, all cases of illegal occupation, and (2) any such officer, or *any person* having reason to suspect such occupation, may enter at any hour of the day, and if refused, the officer or *such other person* may obtain a warrant from a J.P. (3) specifying the hours at which he may enter.

Sec. 98. In case of two convictions for unlawful occupation within three months (whether the persons convicted were the same or not), P.S.C. may close the room for a period, or empower S.A. to close it permanently.

Authorities for Executing the Act.

Sec. 99. (1) The authority, here called S.A., shall be, (*a*) in the City, the Com. of Sewers, (*b*) in the parishes in Sch. A. of M.M.A. 1855, 85 (17), the Vestry, except (*d*) in Woolwich, the Local Board of Health, (*c*) in the districts in Sched. 13, the District Board, and (*e*) in places in Sch. C. the Guardians, or if there be none, the overseers for such place, or the parish in which it is situate, and they shall have the powers of a S.A., but defray their expenses as if they were poor rates. (3) The purposes of this Act shall be included among those for which Vestries or district Boards may appoint committees, and (4) such committees may exercise all the powers of the S.A. in carrying out the Act as the S.A. may delegate them. (5) S.A may acquire and hold land for these purposes, without license in mortmain.

Sec. 100. The C.C., if satisfied that the S.A. have made default in any of their duties in respect of this Act, may take like proceedings and do like acts, and recover from the S.A. all expenses in successful proceedings as have not been recovered from any other person.

Sec. 101. (1) When C.C. complain to L.G.B. that S.A. have made default in any duty, the L.G.B., if satisfied thereof and that it cannot otherwise be remedied, may by order fix a time within which the S.A. shall perform the duty, and in default appoint C.C. to do it, (2) when C.C. shall have all the powers of a S.A., and shall recover from S.A. all expenses, not recovered from any other person, out of the moneys that the S.A. should have applied to the purpose. (3) The C.C. may, without prejudice to other modes of recovery, levy a rate for the amount, requiring the officers of S.A. to pay the money over to them, (4) but if there be any surplus, it shall be returned to the S.A. (5) If a loan be necessary, the C.C. may with consent of the L.G.B. raise it in the name of the S.A. on the same terms and conditions as if it had been borrowed by S.A., and (6) any surplus shall be returned to S.A. accordingly.

Sec. 102. *Repealed* by L.G.A. 1899.

Sec. 103. Expenses incurred under this Act by the S.A.s in London shall (except as otherwise mentioned) be defrayed in the City by the Com. of Sewers, out of their sewer rate or consolidated rate, and elsewhere out of the general rate.

Sec. 104. (1) Expenses incurred by the M.A.M. in respect of ambulances and the conveyance of patients suffering from *D.I.D.* shall be defrayed out of the Metropolitan Common Poor Fund, except those connected with vessels, for which they may borrow under the Metropolitan Poor Act, 1867, &c., and all other expenses, not recovered from the Guardians, shall be defrayed as directed in Sec. 31 of the said Act.

Sec. 105. (1) Vestries and District Boards may borrow for providing hospitals and mortuaries, and other purposes of the "epidemic" regulations in this Act. (2) S.A. may, with consent of L.G.B., borrow for providing (*a*) s.c. and a.p., (*b*) premises, appliances, &c., for disinfection, and (*c*) coroner's courts and *post-mortem* rooms. (3) When the consent of L.G.B. is required and given, that of no other body is necessary.

Appointment of Medical Officers of Health and Sanitary Inspectors.

Sec. 106. (1) Every S.A. shall appoint one or more M.O.H. (2) With the sanction of L.G.B. the same person may be appointed M.O.H. to two or more districts, the L.G.B. prescribing the mode of appointment, apportionment of salary, &c. (3) Every M.O.H. appointed or reappointed after Jan. 1, 1892, shall (unless exempted by L.G.B.) reside (after two months from his appointment or reappointment) in or within one mile from the boundary of his district, on pain of forfeiting his appointment. (4) M.O.H. may exercise any of the powers of S.I. (5) The annual report of the M.O.H. shall be appended to that of the S.A.

Sec. 107. (1) Every S.A. shall appoint an adequate number of persons qualified by knowledge and experience as S.I.s, and may distribute their duties among them. (2) When the L.G.B., on representation of C.C. and after L.E. are satisfied that the S.A. has not appointed a sufficient number of S.I.s, it may order them to appoint such number as it deems necessary, and may fix their salaries. (3) S.I.s shall report nuisances to S.A., and shall inquire into the truth or otherwise of all complaints as to offences and nuisances entered in a book which S.A. shall keep for the purpose, reporting thereon to S.A. at their next meeting, which reports, with the orders of S.A. thereon, shall be entered in a book kept at the office of S.A., and open to the inspection of any inhabitant and of any officer authorized by C.C., and it shall be the duty of the S.I. to make, subject to directions of S.A. or a committee thereof, complaints before J.P.s, and to take legal proceedings against offenders under this Act.

Sec. 108. (1) Subject to the provisions of this Act as to existing officers, the L.G.B. shall have the same powers as to the appointment, duties, salary, and tenure of office of every M.O.H. and S.I. as they have in the case of M.O. under the poor law: and half of their salaries shall be paid by the C.C. out of the Exchequer contribution, the reference in Sec. 24, sub. 2, of the L.G.A. to the P.H.A. being read as including this Act. (2) (*a*) Every M.O.H. shall be legally qualified in medicine, surgery, and midwifery, and also hold a D.P.H. or have been during the three years 1889—1891 M.O.H. to a district or combination of districts in London or elsewhere, having a population in 1881 of 20,000, or have been for three years before 1888 M.O. or M.I. under the L.G.B. (*b*) A M.O.H. shall be removable only by the L.G.B., or by S.A. with consent of L.G.B. after consideration of representations of S.A. (*c*) A M.O.H. shall not be appointed for a limited time. (*d*) Every S.I. appointed after Jan. 1, 1895, shall hold such certificate obtained by examination as the L.G.B. may from time to time approve, or have been S.I. for the three years 1892—1894 to a London or U.S.D. having a population of 20,000.

Sec. 109. A S.A. may, with consent of L.G.B., make temporary arrangements for the performance of the duties of M.O.H. or S.I., such person to have, subject to the terms of his appointment, all the powers, &c. of such an officer.

Sec. 110. (1) For the purposes of this Act any vessel ((3) not belonging to H.M. Government) lying in waters within a S.D. (subject to provisions as to the Port of London) shall be deemed a house and (2) its master the occupier.

Port S.A. of Port of London.

Sec. 111. The mayor, commonalty, and citizens of the City of London shall continue to be the S.A. for the Port of London, and shall defray all expenses as such from their corporate funds.

Sec. 112. (1) L.G.B. may by order assign to P.S.A. of London any or all the powers, rights, liabilities, duties, &c. of a S A. under P.H.A. 1875, or under this Act with or without modifications, and with any B.L. extended thereto by the order, and may extend the jurisdiction of the P.S.A. to the whole or parts of riparian districts within or without the County of London. (2) The L.P.S.A. may acquire and hold land without licence in mortmain. (3) The L.P.S.A. may with consent of L.G.B. delegate any of its powers in any riparian district to the L.S.A., but no S.A. shall otherwise exercise such powers. (4) Riparian authority means any S.A. under this Act, or under the P.H.A. any part of whose district forms part of or abuts on any part of the Port of London, and any conservators, commissioners, &c. having authority over any part thereof.

Sec. 113. The Secs. [130, 134, 135, 140] of the P.H.A. set forth in Schedule I. of this Act, having relation to cholera, &c., shall extend to London.

Bye-Laws.

Sec. 114. All B.L. made by C.C. or any S.A. shall be according to Secs. 182—186 P.H.A., provided that the C.C. shall consider any representations of the S.A. concerned, and shall, at least two months before applying to L.G.B., send copies of the bye-laws to every such S.A.

Legal Proceedings.

Sec. 115. (1) When a S.A. have power to enter any building or premises under this Act, they may do so by any of their members, or officers, or persons authorized by them generally or for the particular case. (2) (*a*) The person so claiming to enter shall, if required, produce a written authority from the S.A.; and (*b*) if any person obstruct the entry of (i) an officer of the S.A. or other person having a written authority to enter for carrying out an order of C.S.J., or (ii) if the obstruction be clearly intended to prevent detection of an offence against the Act, or (iii) be such as is punishable under any provisions thereof or any B.L., he shall be liable to a fine < £5. (3) If (*a*) J.P. is satisfied by sworn information that (*a*) there has been reasonable ground for the entry, and obstruction thereto, and that notice of intention to apply for warrant has been given, or that such notice would defeat the object of the entry, or (*b*) that there is reason to suspect a contravention of the Act or B.L., and that application for admission, or notice of intention to apply for warrant would defeat the object in view, J.P. may by warrant authorize S.A., their officers, &c., to enter by force if necessary and with assistants. (4) Any person obstructing entry under a warrant granted by J.P. shall be liable to a fine < £20, or, if a greater penalty be authorized by any Act, to either fine. (5) Such warrant shall continue in force till its object is attained, and (6) where this is the prevention of overcrowding, the warrant may authorize the entry at any hour of day or night specified therein.

Sec. 116. (1) If any person obstruct any officer or agent of the S.A. in execution of this Act, or (*b*) pulls down, defaces, &c., any notice, B.L., &c., put up by S.A., or (*c*) any property of same, he shall be liable to a fine < £5. (2) If occupier prevent owner from carrying out provisions of this Act, a P.S.C. shall, on complaint, order him to permit execution of necessary work on pain of D.P. < £5 after 24 hours. (3) If occupier refuse to state or misstate name and address of owner to the S.A. or their agents, he shall be liable to fine < £5 unless he show cause for refusal.

Sec. 117. (1) All summary proceedings shall be conducted in accordance with the S.J.A. (2) Proceedings for recovery of sums not over £50 may be taken in County Court as if for debts. (3) No proceedings shall be taken by C.C. against S.A. without consent of L.G.B., except for recovery of expenses or money due.

Sec. 118. A person charged with an offence under this Act, or the wife or husband of such person, may be called, sworn, and examined as an ordinary witness in the case.

Sec. 119. (1) All fines shall be paid to S.A. for their expenses in execution of this Act, but fines imposed on S.A. shall be paid to C.C. (2) Things forfeited may be sold or disposed of as the court ordering forfeiture may direct.

Sec. 120. (1) When a nuisance is caused by the acts or default of several persons, proceedings may be taken against any one or more or all of them, and any one or more be ordered to abate the same so far as he or they be answerable therefor, or to discontinue any act contributing thereto; and the court may distribute costs and fines as it thinks fair and reasonable, (2) and the death of any one shall not affect proceedings against the rest. (3) Where some persons only have been proceeded against, they may, without prejudice to other remedies, be entitled to recover in a summary manner from the others a fair proportion of the costs of proceedings, abatement, &c., they may have paid into the court. (4) It shall be sufficient to describe the person proceeded against as the "owner" or "occupier," as the case may be.

Sec. 121. Any costs and expenses recoverable from the owner may be recovered from the occupier, who shall be entitled to deduct the amount from his rent, provided that he shall not be required to pay any larger sum at one time than the amount of rent due from him for the time being, unless he refuse to disclose to the S.A. the amount of rent due and the name and address of the person to whom it is payable; and the burden of proof that the rent is less than the amount demanded shall rest on occupier. Nothing in this section shall affect any contract between owner and occupier, or landlord and tenant.

Sec. 122. A Judge or J.P. shall not be disqualified from acting by reason of being a member of S.A., or one of other persons liable to contribute to or be benefited by any rate or fund out of which expenses of S.A. are defrayed.

Sec. 123. C.C. or S.A. may appear in any court or legal proceedings by their clerk or any officer or member authorized generally or specially, who shall then be at liberty to institute and carry on any legal proceedings on their behalf.

Sec. 124. No member or officer of a C.C. or S.A. shall be personally liable for any contract entered into, or thing done by him on behalf of the Board if *boná-fide* for the purpose of executing the Act, and his expenses shall be borne by and repaid out of the appropriate fund, except so far as any member or members of such body may be surcharged by the auditor for expenses he or they had illegally authorized.

Appeals.

Sec. 125. Save as otherwise provided in this Act any one may appeal from C.S.J. to C.Q.S.

Sec. 126. Appeals to C.C. against notices or acts of S.A. shall be conducted according to Secs. 211, 212, of M.M.A. as modified by L.G.A. and set forth in Schedule I. of this Act.

Notices.

Sec. 127. Orders shall be under the seal of the C.C. or S.A., and all orders, notices, &c., be in writing and signed by the clerk or by the officer by whom they are given or served.

Sec. 128. (1) Service on an individual shall be at his usual or last known residence, or if addressed to O. or *O.*, to some person on the premises, or if there be no one on whom it can be served, then it or a copy shall be conspicuously affixed to the premises; or sent by post. (2) Service on a C.C. or S.A. may be by delivering at or sending by post to their office the notice addressed to the S.A., C.C., or clerk to the same. (3) When served on the "owner" or "occupier," no further name or description is needed.

Sec. 129. Secs. 293—296 P.H.A. 1875, set forth in Schedule I. shall apply to all L.G.B. inquiries under this Act.

Sec. 130. The forms in Schedule III. or forms to the like effect, varied as necessary, may, unless other forms are prescribed by S.J.A. 1879, be used for all purposes.

Sec. 131. Relates to Lewisham and Penge.

Sec. 132. This Act shall not extend beyond London unless when necessary for its execution within the county.

Special Provisions as to City.

Sec. 133. There shall be no appeal from C. of S. to C.C.; the C.C. cannot proceed against C. of S. for default, nor shall their B.L. extend to the city.

Sec. 134. If L.G.B. be satisfied that the C. of S. have failed in their duty as to nuisances, L.G.B. may authorize any officer of the City Police to take proceedings, recovering from C. of S. any expenses not paid by person proceeded against, but such police-officer may not enter a dwelling-house without consent of occupier of same or warrant of J.P.

Sec. 135. In case of failure by C. of S., the L.G.B. may order them to perform their duty within a time named, and in default issue a writ of mandamus, or authorize some person to perform the duty, his costs and a reasonable remuneration, named in the order, to be paid by the C. of S., and recoverable by order of the High Court. Such person to enjoy all the powers of the C. of S. except that of levying rates. The expenses of performing the duty of the C. of S. with costs to be paid by them out of the local rate. If the C. of S. refuse to pay fourteen days after demand, L.G.B. may authorize any person to levy the amount out of the local rate, empowering him to levy and require payment by the officers of the C. of S. as if he were the C. of S., and if L.G.B. deem a loan necessary for the purpose, to raise such, charging local rate with principal and interest. L.G.B. may certify beforehand in any case the probable sum required. All such charges, &c., shall be debts due and recoverable from the C. of S., and the surplus, if any, shall be repaid to them. "Expenses" shall include all sums payable by order of L.G.B., or the persons they may appoint.

Saving Clauses.

Sec. 136. Nothing in this Act shall authorize any S.A. to injuriously affect the navigation of any river or canal, or any legal rights in any river, reservoir, or other water or water-supply, unless consent of persons entitled thereto be first obtained.

Sec. 137. Nor affect powers of Thames Conservators.

Sec. 138. All powers rights and remedies under this Act shall be in addition to those conferred by other acts, laws, and customs, which may be enforced as if this Act had not been passed.

Temporary Provisions.

Sec. 139. (1) In the case of "existing officers," *i. e.* M.O.H., or S.I., appointed before the passing of this Act, its provisions shall be qualified as follows :—

(*a*) Where a portion of his salary is paid by C.C., the L.G.B. shall have the same powers as in the case of district M.O. of poor-law unions.

(*b*) In other cases L.G.B. may prescribe the duties and qualifications of a M.O.H.

(*c*) Subject to such powers of the L.G.B., the S.A. may fix salary of M.O.H., and he shall be removable at their pleasure.

(*d*) Inspectors of Nuisances shall henceforth be called S.I.s.

(2) The requirements of this Act shall not apply to any M.O.H. appointed before January 1, 1892, and this Act shall not prevent any person already holding together the appointments of M.O.H. and of poor-law M.O. from continuing to do so.

Sec. 140. *Repealed.*

Interpretation.

Sec. 141. Unless the context otherwise require—

"London" = administrative County of London.

"C.C." = London C.C.

"M.A.M." = managers of M.A. district.

"Street" = any highway, public bridge, road, lane, footway, square, court, alley, or passage, whether a thoroughfare or not, and whether there are houses therein or not.

"Premises" = messuages, buildings, lands, casements, and hereditaments of any tenure, open or enclosed, built on or not, public or private, and whether maintained or not under statutory authority.

"House" = houses, schools, factories, and buildings where any persons are employed.

"Building and House" include the curtilages, and those wholly or partly erected under statutory authority.

"Bake-house" = any place where bread, biscuits, or confectionery [which meat-pies are not] are baked for profit or sale.

"Vessel" = any vessel or boat used in navigation.

"Hospital" = any premises or vessel permanently or temporarily used for reception of sick persons.

"Master" = the person in occupation, charge, or control of any house, or part thereof, or of any vessel; or in the case of houses wholly let in tenements, or occupied by lodgers, he who, on his own account or as agent for another, receives the rents paid by the lodgers.

"Trade-refuse" = refuse of any trade, or business, including building operations.

"House-refuse" = any ashes, breeze, rubbish, filth, or night-soil, but no trade-refuse.

"Street-refuse" = dust, dirt, rubbish, mud, road-scrapings, ice, snow, and filth.

"Owner" = he who for the time being on his own account, or as agent for another, receives or would receive the rack-rent, *i. e.*, not less than ⅔ the full annual value, or of the rent which a tenant might pay, he defraying all tenant's rates and taxes, and the landlord undertaking repairs and insurance.

"Cattle" include sheep, goats, and swine.

"Slaughterer and slaughter-house" are used when the flesh of the animals is intended for use as butcher's meat; and

"Knacker and knacker's yard" when it is not to be so used.

"Source of water-supply" = any means or work, natural or artificial, for the supply of water, whether so used or not, if capable of being so used.

"Sanitary convenience" = any water or earth closet, privy, urinal, &c.

"Ashpit" = any receptacle fixed or movable for deposit of ashes or refuse.

"Cisterns" include water-butts.

"Day" = VI. a.m. to IX. p.m.

"Dairy" = any farm, farm-house, cow-shed, milk-store, milk-shop, or place whence milk is supplied, or where it is kept for sale.

"Dairyman" includes any cowkeeper, vendor of milk, or occupier of dairy.

Repeal.

Sec. 142. (1) For Acts repealed, to what extent, and from what date, see Schedule IV., but—

(2) (*a*) When any enactment extends beyond London, it is not hereby repealed except in London.

(*b*) Such repeal of any Act shall not invalidate securities given, or orders, rules, bye-laws, notices, &c., made under the same, nor offences committed, nor penalties imposed, before the repeal; and all B.L. notices, &c., made under the same, shall (unless incompatible with this Act) continue in force.

(3) When a C.C. or S.A. are required by this Act to make B.L. for any purpose for which they have not such already, the first B.L. shall be submitted to the L.G.B. within six months of the passing of this Act.

(4) Enactments to be repealed on the coming into operation of B.L., as expressed in Schedule IV., shall expire, whether such B.L. be made or not, 12 or within 18 months, as fixed by order in Council, of the commencement of this Act.

(5) So much of the P.H.A. 1875, as re-enacts Secs. 51, 52 of San. Act, 1866, and Secs. 34—36 of P.H.A. 1872, shall extend to London.

(6) Officers appointed under repealed enactments shall continue in office subject to provisions as to existing officers.

(7) When in any enactment, order of S.S. or L.G.B., or other document already in force, reference is made to any provisions of an Act hereby repealed, it shall be read as if referring to the corresponding or substituted provisions of this Act.

Sec. 143. This Act shall come into operation Jan. 1, 1892.

Sec. 144. This Act may be cited as the Public Health (London) Act, 1891. P.H.(L.)A.A., 1893, permits L.A. to borrow for wharves, destructors, &c.

SECTIONS OF P.H.A., 1875, APPLICABLE TO LONDON.

Secs. 108 to 115, 130, 134, 135, 140 (Sec. 2, of P.H.A. 1889), 182—186, 293—296 (and 211, 212, of M.M.A., 1855).

PUBLIC HEALTH (AMENDMENT) ACT, 1890.

This Act contains a number of provisions amending existing Acts, and extending the powers of S.A., although in Parts II., IV., V., and many sections of Part III., as regards matters not concerned with the public health; and of such as are of the nature of sanitary provisions, very few are compulsory.

Secs. 10, 20, 21, 22, 23, 28, and 29 have been wholly or partly introduced into the P.H.(L.)A., and others are taken from, or will be introduced into the Building Acts of the metropolis.

PART I. (GENERAL).

SEC.

2 Part I. extends to England, Wales, and Ireland, but not to Scotland, or to London. Part III. is adoptive or optional U.D., and, with the limitations indicated, in R.D., by resolution of L.A. passed at a meeting of which one full month's notice has been given, and when passed advtd. in local papers, posted on church or chapel doors, and otherwise published for at least one month before the date of coming into operation; and a copy sent to the L.G.B.

4 All expenses of its execution to be paid as those of the P.H. Acts.

5 L.G.B. may declare any of the provisions of Part III. to be in force in a R.S.D., and may invest the R.S.A. with the powers of an U.S.A., as under P.H.A. § 276, the date of such declaration being deemed the date of its adoption.

6 Legal proceedings to be conducted as under P.H.A.

7 Any person aggrieved by—(*a*) any order, judgment, &c., of the L.A., (*b*) the withholding of any order, licence, &c., given by L.A., or (*c*) by any conviction order, &c., of a C.S.J. under this Act, may appeal as provided by S.J.A. to a C.Q.S., except in cases in which under P.H.A. § 268 the appeal is to L.G.B.

8 One summons under this or the P.H.A. may contain more than one sum.

9 All provisions as to B.L.s in P.H.A. §§ 182 to 186, shall apply to those made under this.

10 P.H.(L.)A. § 138. All powers hereby granted are cumulative, *i.e.* in addition to those possessed under other Acts, and shall not exempt any person from any penalty incurred under them, provided that, except in the case of a D.P., more than one penalty shall not be enforced for the same offence.

11 (1) "Ashpits" shall include tubs, pails, &c.

(2) Paving shall admit asphalt, &c., and any material satisfactory to L.A.

(3) L.A., U.A., and R.A., are equivalent to U.S.A. and R.S.A. of P.H.A.

"Sanitary convenience" includes w.c., c.c., a.p., privies, urinals, &c.

"Daily penalty" is a new term to indicate a penalty imposed for each day an offence is continued after conviction, or in some cases after notice. Other terms have same meaning as under P.H.A.

SEC.

12 Secs. 5 and 41 shall not apply to Ireland. Otherwise P.H.A. = P.H.(Ireland)A. L.G.B. = L.G.B.(Ireland). S.S. = Chief Secretary. Abode in England = one in Ireland.

For references to particular sections of the P.H.A., 1875., the corresponding sections of the P.H.(I.)A., 1878, are to be substituted.

P.H.A.	P.H.(I.)A.	P.H.A.	P.H.(I.)A.
38	48	165	102
41	51	229	232
84	95	230	233
116	132	268	268
117	133	306	272
157	41	116–119	132–135
158	42	182–186	219–223

PART III. (SANITARY).

16 For throwing or causing to pass into a sewer or drain, anything that may injure it, or interfere with the free flow, the penalty shall be a sum < £10 and D.P. < £1.

17 (1) Chemical refuse, waste steam, or any liquid above 110° F., which is likely, alone or with the sewage, to cause a nuisance or be injurious or dangerous to health, shall not be passed into any sewer of a L.A. or drain communicating therewith, under a penalty < £10, and D.P. < £5.

(2) Any Officer of L.A. may enter any premises to ascertain if this provision is contravened, and if refused, having given to the person in charge of the premises reasonable notice of his intention to complain to a J.P., may obtain from the J.P. an order for his admission, which, if the offence be proved, shall remain in force until it have ceased, or the work necessary to prevent its recurrence be completed.

(3) A person shall not be liable to a penalty for an offence committed within seven days after the L.A. have given him notice of the provisions of this section. But one notice only is required for the same person.

18 (1) When an O. or *O.* is entitled to drain his premises into a sewer of the L.A., the L.A. shall, if he request and pay the cost in advance, make such drain or communication. (2) The cost shall be estimated by the surveyor of the L.A., but if the O. or *O.* be dissatisfied, he may apply to have the sum fixed by a C.S.J. if it < £50, or by arbitration if > £50. (3) L.A. may agree with an owner themselves to make or alter any sewer or drain which he is required or desires to make or alter.

SEC.

19 Where two or more houses belonging to different owners are connected with a public sewer by one private drain, an application may be made under P.H.A. § 41, and the L.A. may apportion the cost incurred by them among the owners, as determined by their surveyor, or in case of dispute by a C.S.J., recovering the expenses summarily, or in U.D., as private improvements.*

	P.H.(L.)A.	
20	45	Identical except in use of new term "Sanitary convenience."
21	46	Identical.
22	38	Identical, and where this part of the Act is adopted, P.H.A. § 38 [which is less exacting than this] shall be repealed.
23	Cf. 39	Extension of P.H.A. § 157 (where this part of Act is adopted P.H.A. § 158 is repealed).

(1) Every U.A. shall be empowered to make B.L.s with respect to water-supply or flushing of w.c.'s. Structure of floors, hearths, stairs, and the height of rooms to be used for *H.H.* Paving of yards, &c., attached to dwellings. Provision, in new streets, of secondary means of access for removal of refuse. (2) B.L.s hereby made in regard of the drainage of new buildings, of s.c.'s, and flushing of w.c.'s, &c., may be extended to older buildings. (3) These additional provisions and those of sub-sec. 3 and 4 of P.H.A. § 157, shall be extended so as to enable R.S.A. to make such B.L.s and to enforce same as if empowered by L.G.B. (4) Every L.A. may make B.L.s to prevent buildings from being so altered as to contravene the Acts.

24 No room, any portion of which is immediately over privy (not a w.c.), c.p., a.p., &c., shall be occupied by day or by night as a dwelling, sleeping, or work-room, under penalty (one month after adoption of this part of Act, and after seven days' notice from L.A.) < £2, and a D.P. < 10*s*.

25 No new building shall be erected on ground filled up with soil impregnated with organic or offensive matter, until such have been removed or been rendered or become innocuous, under a penalty > £5, and D.P. < £2.

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* In districts where the P.H.(A.)A. has been adopted, the effect of sec. 19 in procedure is in numerous instances to transform a single private drain into a sewer, and subsequently it may be into a system of combined drainage, which means that a single owner, the L.A., and several owners, would be successively responsible for its proper order and repair. By a single sale of part of the property the same system of combined drainage would again become a sewer, and the L.A. have to bear cost of its maintenance.

SEC.

26 An U.A. may make B.L.s in respect of (1) (*a*) the times for conveying any fæcal or offensive matter through the streets, (*b*) the proper construction and covering of vessels, carts, &c., so employed, (*c*) the compulsory cleansing of any place where such matter has been dropped in removal or carriage; and (2) when the L.A. undertakes or contracts for the removal of house refuse requiring the occupiers to facilitate their work in such manner as L.A. think fit.

27 When any court, or a back passage common to several houses, not being a highway repairable by the L.A., is not regularly kept clean and free from rubbish, &c., L.A. may cause it to be swept and cleaned, apportioning the cost among the occupiers as their surveyor, or in case of dispute a C.S.J. determines, and recovering the expenses summarily.

28 P.H.A. § 116—119, shall extend to "any article intended for the food of man, sold or exposed for sale, or preparation for sale," and a J.P. may order its destruction under § 117, although it have not been seized as under § 116.

29 P.H.(L.)A. 20 (2). Identical.

30 Notice of change of occupation of any building licensed or registered as a slaughter-house, shall be given to the S.I. within one month, under a penalty < £5. This enactment shall be endorsed on all licenses granted after adoption of this part of the Act.

31 P.H.(L.)A. 45 (5). The same.

32 The penalty under P.H.A. § 84, shall be a fine < £2, and D.P. < 5*s*.

33 Buildings described in deposited plans, either before or after adoption of this part of the Act, otherwise than as dwelling-houses, shall not be occupied as such except by a caretaker and his family, and any person so using or permitting them to be so used, shall be liable to a penalty < £5 and a D.P. < £2, unless such building have in the rear, adjoining to and exclusively belonging thereto, such open space as any Act or B.L. may require for dwelling-houses, and have undergone such structural alterations, if any, as may in the opinion of the S.A. be necessary to fit it for a dwelling-house.

34 to 46 Relate to matters not strictly of a sanitary nature.

47 No cinders, bricks, stone, rubbish, filth, &c., to be thrown into any river or water-course under a penalty < £2.

50 The following sections shall be applicable in R.S.D., 16, 17, 18, 19, 21, 23 (3, 4), 25, 26 (2), 28, 32, 33, 47.

PUBLIC HEALTH ACT, 1875.

[SO FAR AS IT DIFFERS FROM P.H.(L.) ACT, 1891.]

SEC. Definitions. Three only are of practical importance, viz.:

4 *Owner* = person for the time being receiving the rack rent of the lands or premises, whether on his own account or as agent or trustee for another person, or who would receive the same if they were so let.

Rack rent = rent not less than $\frac{2}{3}$ the full net annual value of the property.

Full net annual value = rent at which the property might reasonably be expected to let from year to year free from all usual tenant's rates and taxes, tithe commutation and rent-charge, if any, and deducting therefrom probable annual cost of repairs, insurance, &c., necessary to maintain the same in a state to command such rent.

10 In addition to the powers conferred by this Act, every U.S.A. shall henceforth exercise exclusively those attaching to any L.A., under the Bakehouse Regulation Act; Artisans' and Labourers' Dwelling Acts, or any amending the same [*i. e.* the H.W.C.A.]. Where any of these Acts are in force, these powers shall be at once transferred to U.S.A., and where not, the S.A. may adopt them. When any local Act, save for river conservancy, confers on any commissioners, trustees, &c., like powers to these herein set forth, but not for personal profit, they shall henceforth be vested in U.S.A.

11 The additional powers of R.S.A. mentioned in the P.H.A. relate to bakehouses only [but the H.W.C.A., 1888, unlike those it supersedes, applies to all S.A.s].

12 All property previously held by any L.A., and all liabilities incurred, are transferred to the S.A. hereby constituted.

13 All existing and future sewers within a S.D. are vested in the S.A., with all buildings, works, &c., belonging thereto, except those—(1) made by any person or company for their own profit; (2) made and used for draining or irrigating land; and (3) under Commissioners of Sewers appointed by the Crown. Provided that those within the district made by or transferred to some other L.A. or other authority empowered by Act of Parliament to make or hold sewers shall (subject to any agreement to the contrary), vest in such other authority.

14 L.A. may purchase or acquire any sewer, with or without buildings, works, &c., or any rights in such sewer;

and any person may sell or make over the same to L.A. retaining such right of user as he had before.

15 Every L.A. shall keep existing sewers in repair, and make such others as may be necessary.

16 Any L.A. may carry a sewer through, under, or across any highway or street, or cellar under pavement or street, and if on report of surveyor it appear necessary, after reasonable notice to owner or occupier, into any land whatever. Also, subject to provisions of this Act relating to sewage works without their district, may do the same elsewhere for purposes of discharge or distribution of sewage.

17 They shall not, however, discharge sewage or foul water into any river, lake, pond, or canal, without efficient purification, so as not to deteriorate such stream or water.

18 They may alter any existing sewers or abolish such as they deem unnecessary on condition of providing others equally effectual; and that they do not cause a nuisance.

19 They *shall* cause their sewers to be constructed, covered, *ventilated*, and cleansed so as not to be nuisances.

20 They *may* keep a map of the sewerage of their district, open to inspection of all ratepayers.

21 Every O. & *O.* is entitled to connect his drains with the sewers, on giving such notice to, and complying with the regulations of the S.A. respecting the mode of connection, to the satisfaction of the surveyor or person appointed by them to superintend such connections.

Persons connecting drain with sewer in violation of above condition incur penalty < £20, and closure of connection by L.A. at offender's cost.

22 O. or *O.*s, without district may connect in like manner, on terms and conditions mutually agreed on, or settled by C.S.J. or by arbitration at option of the O. or *O.*

23 If any house in district be without sufficient drains, L.A. may require O. or *O.* to make such according to their specification to any of their sewers within 100 feet of the [boundary of the ?] site of house, or if there be no such sewer, into a proper covered cess-pit, not under any house. In default L.A. may do the work and recover cost, or declare it a P.I.E. Provided that when a new sewer would cost less than the connection of several houses with an existing one, L.A. may construct such new sewer apportioning expense among *owners*, or making it a P.I.E., and require owners to connect their drains therewith.

24 When any house is connected with a sewer sufficient for its own drainage, but in the opinion of L.A. objectionable in other respects, L.A. may close such drain on making

another properly connected with another sewer, and do whatever else may be necessary at their own cost as expenses properly incurred in execution of this Act.

25 In U.S.D. (and in R.S.D. obtaining urban powers under § 276) every house newly-built or rebuilt from groundfloor, shall be provided with drains as under § 23, under a penalty < £50.

26 Any one in an U.D., who, without written consent of U.A., (1) builds over any sewer of the L.A., or (2) makes any cellar or arch under the *carriage-way* of any street, shall forfeit to U.A. £5, and D.P. of £2 after notice; and U.A. may pull down or alter such structure as they think fit, recovering cost summarily from offender.

27 For purposes connected with the disposal of sewage a L.A. may—(1) construct, or (2) purchase, take on lease, or contract for use of any works; or (3) contract to supply any person with sewage for any term not exceeding 25 years, and as to the construction of the works necessary thereto, either within, or subject to §§ 32—34, &c. without their district, *provided* no nuisance arise therefrom.

28 One L.A. may, with consent of L.G.B., agree with another to connect their sewers with those of the latter, on conditions to be mutually agreed on, or in case of dispute settled by L.G.B. Provided that storm-waters be so far as practicable excluded, and that the former do not (subsequently) without the consent of the latter take into their sewers the sewerage of other districts or places.

29 Provided no nuisance is created, a L.A. may deal in any way with lands held by them for the disposal of sewage, leasing them for terms not exceeding 21 years, farming such land and disposing of the produce, or contracting with any person to take the whole or a part of the produce.

30 A L.A. may contribute to the expenses of any person with whom they have contracted to supply him with sewage, or may become shareholders in a company undertaking to dispose of or utilize the same.

31 Sewage works for agricultural purposes shall be deemed "improvements of land," and the provisions of the Imp. of Lands Act, 1864, shall apply accordingly.

32 Three months at least before commencing any sewers or sewerage works without their district, a L.A. shall advertise their intention in one or more newspapers circulating in those districts, giving full particulars as to the nature of the intended works, the parishes, roads, streets, and lands through which they will pass, the termini, &c., and naming a place where plans of the works shall lie open to inspection

SEC.

at all reasonable hours, and shall serve a copy of such notice on all known or reputed O. or *O.* and lessees of such lands, and on the overseers, trustees, and other authorities having the care of such roads and streets.

33 If any of the aforesaid persons, or any others affected by the intended works, shall serve written notice of objection on the L.A. at any time within the said three months, the work shall not be commenced, unless the objection be withdrawn, until the sanction of L.G.B. be given after an inquiry as under § 34.

34 L.G.B. may, on application of L.A., appoint an Inspector to hold a L.I. into the proposed scheme, and the objections thereto, and after considering his report may allow the scheme with or without modifications or disallow it.

SECS.	P.H.(L.)A.	
35 36	37	For differences, see notes.
37	—	Earth-closets may, if L.A. approve, be held to satisfy requirements as to w.c.s ; and allowance be made in any water-rate for reduced demand, and the L.A. may undertake, or contract for the supply of dry earth or other deodoriser. The term earth-closet includes pails, &c., of any kind approved by L.A.
38	38	See notes, also P.H.(A.)A., § 22.
39	44	See notes.
40	40	
41	40	,,
42	30 (1) 32	,, ,,
43	34	,,
44	16	,,
45	—	Any U.A. may provide in proper places receptacles for deposit and collection of ashes, dust, and rubbish ; and fit buildings, &c., for any matters collected by them in pursuance of this Act.
46	Cf. 60	Where on certificate of M.O.H. or any two M.M., it appears to any L.A. that a house or part of a house, is in a filthy, unwholesome state, or injurious or *dangerous* to health, or that the cleansing of the same would tend to prevent or check infectious disease, L.A. shall give written notice to O. or *O.* to have the same white-washed, cleansed or purified within

SEC.	P.H.(L.)A.	
		a specified time; failing which he shall be liable to a penalty < 10*s.*, for each day's default, or L.A. may do the work and recover summarily.
47 (1) (2) (3)	17	See notes.
48	Cf. 43	See note on P.H.(L.)A., § 43.
49	35	,,
50	36 (2)	,,

[Sections 51 to 67 of the P.H.A. deal with the powers and obligations of L.A. in respect of public water supply; and since at present the Metropolitan Water Companies enjoy a monopoly, and the L.C.C. has no power of acquisition, these sections have no counterparts in the P.H.(L.)A. except § 64, which corresponds nearly to P.H.(L.)A., § 51, *q. v.*]

51 Any L.A., U. or R. may provide public water supply to the whole or any part of its district, or in the case of R.D., to any C.P. or part thereof, for all purposes, and many (1) construct and maintain W.W., dig wells, &c., (2) lease, hire, or with consent of L.G.B., purchase any existing W.W. waters or rights to take or convey water within or without their districts, and any rights, &c., of any W. Co. (3) Contract with any person for a supply of water.

52 Before constructing W.W. within the area of supply of any W. Co. authorized by Parliament, the L.A. shall give written notice to every such Co. of their intention, of the purposes for which, and so far as is practicable, the extent to which they require such water. The L.A. may not construct such W.W. so long as the Co. is able and willing to supply water sufficient and proper for all reasonable purposes for which it is required by the L.A., and all questions as to the ability of the Co., the quantity and quality of the water, and the reasonableness of the purposes, are to be decided by arbitration, as well as the terms of supply, if and so far as the Co.'s charges are not fixed by Parliament.

53 At least two calendar months before commencing to construct any reservoir (other than service reservoirs holding less than 100,000 gallons), L.A. shall give notice in local newspapers, and if any person who would be affected serve on the L.A. within that time notice in writing of his objection, the work shall not, unless the objection is withdrawn, be begun without authority from the L.G.B. For this the L.G.B. may, on the

application of the L.A., appoint an inspector to hold a local inquiry, and on consideration of his report issue an order disallowing or allowing, with or without modifications, the proposed work.

54 L.A. supplying water shall have like powers and be under like restrictions in carrying water mains within or without their district as of sewers. See §§ 16 and 32.

55 L.A. shall provide and keep in any W.W. constructed or purchased by them a supply of *pure* and *wholesome* water, and may provide a constant high service.

56 L.A. may charge a water-rate assessed on the net annual value as determined for general rating purposes, or may make any agreement with the owner or occupier as to terms, having the same powers of recovering such rents and payments as they have of water-rates.

57 To enable L.A. to provide water supply, the W.W. Clauses Act of 1863, and Secs. 28—34, 44—53, 54—60, 61—67, and 68—74, of the W.W. Clauses Act, 1847, shall be incorporated into this, with the omission from § 44 of reference to the consent of the owner or his agent, and the additional provision that the occupier may deduct from the rent payable by him to the owner any rent paid by him for pipes and works.

58 L.A. may agree with any person to supply water by measure, and as to the charge, rent of meters, &c., and shall keep all meters, &c., in correct order and repair at their own expense, and shall have access at all reasonable times to inspect, replace, &c., the same.

59 The register of the meter shall be *primâ facie* evidence of the quantity consumed, any dispute between L.A. and consumer to be decided by C.S.J., which shall apportion costs, and whose decision shall be final.

60 Any person wilfully or by culpable negligence causing any injury to a meter or its fittings belonging to L.A., tampering with the index, or fraudulently abstracting or using the A.'s water, shall (without prejudice to any other rights or remedies of the L.A.) be liable to penalty < £2, and to pay the L.A. for the damage done. The existence of means for such interference with meter, or for abstracting water, shall be sufficient evidence of fraud.

61 A L.A. supplying their own district may, with consent of L.G.B., supply water to L.A. of adjoining districts on terms to be mutually agreed on or determined by arbitration.

62 When, in opinion of surveyor of L.A. [not of M.O.H.], any house is without proper water supply, and it could

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Cf. 48 of P.H. (L)A. be supplied at a cost not exceeding the water-rate authorized in the district, or where is no such local act, not more than twopence a week, or such cost as the L.G.B. on application of L.A. shall deem to be under the circumstances a reasonable charge, L.A. shall by written notice require the owner to obtain such supply and to do all works necessary for the purpose. If he fail to comply, the L.A. may do the work themselves, or may contract with any W.Co. supplying their district, charging the cost as a private improvement and levying a water-rate which, as well as the cost of providing supply, shall be summarily recoverable from the owner.

63 Any W.Co. may contract to supply L.A. or lease their works to them, or may, in the case of those registered under the Companies' Act, 1862, by special resolution as therein provided, and in the case of other Cos., by one passed by three-fourths in number and value of the members present in person or by proxy, at a meeting specially convened, sell and transfer their works, property, privileges, powers, and liabilities to L.A. on terms to be mutually agreed on.

64 See note on P.H.(L.)A., § 51.

65 L.A. may supply water from any works constructed or purchased by them to any public baths or washhouses or for manufacturing or trading purposes, on terms mutually agreed on, and may supply it gratuitously to public baths and washhouses not conducted for private profit "or supported out of poor or borough rates." [The meaning of this exception is obscure, since public baths and washhouses are vested in L.A., and of course maintained out of the rates.]

66 Every U.A. shall provide and maintain fire-plugs, hydrants, &c., with a sufficient supply of water in case of fires, and agree as to terms with any W.Co. They shall paint on walls of adjacent houses [the owner or occupier having no power to object] any necessary indication of their position, &c.

67 In Oxford and Cambridge the L.A. may supply water to any college or hall on such terms as may be from time to time mutually agreed on.

P.H.(L.)A.

68 52 Identical.

69 L.A. may, with sanction of Attorney-General, take proceedings by indictment bill in Chancery, either in their own name or in that of any other person with his consent, for the protection of any

SECS.	P.H.(L.)A.	
		[particular] water-course from pollution by sewage either within or without their district, and all costs whatever incident thereto shall be deemed expenses properly incurred in the execution of this Act.
70	54	See notes.

Cellar, Dwellings and Lodging-houses.

71	96 (1)	See notes.
72	96 (1)	,,
73	96 (2)	,,
74	96 (7-8)	,,
75	98	Identical

N.B. *Definition of a common lodging-house.*—That given by Sir A. Cockburn and Lord Hatherley in 1853 seems to be accepted by the L.G.B., viz. "That class of lodging-houses in which persons of the poorer class are received for short periods, and though strangers to one another, are allowed to inhabit one common room." By "strangers" they meant "lodgers promiscuously brought together as distinguished from the members of one family or household" [or such parties as football teams, &c., on tour], and they considered the period of letting to be unimportant for the definition. Public-houses, &c., licensed pursuant to 9 Geo. IV. c. 61, &c., are exempt from the provisions of this Act.

"Keeper" is nowhere defined. They were of opinion that "when a person neither resides in the house nor exercises any control over its management, but simply receives the rent, he cannot be considered the keeper; but where the owner, though not resident in the house, exercises control either in person or through an agent, there was no doubt as to his being the keeper." In general the person who derives immediate profit from the letting of the lodgings may be regarded as the "keeper."

The following sections 76—79 are not in P.H.(L.)A., these being regulated in London by S.A.(A.)A., 1874, sec. 46—49.

76 Every L.A. shall keep a register of all common lodging-houses, the number of persons that may be received, and the names and addresses of the keepers. A copy of every entry certified by the clerk of the L.A. shall be received in court, &c., as evidence, and be supplied gratis to any person applying for one.

77 No one may keep a common lodging-house unless he and the house be registered as aforesaid, though his widow or one of his family [*i.e.* a relative acting as

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administrator, &c.] may keep the house on for one month after his death without being registered as keeper.

78 No house shall be thus registered, until it have been inspected and approved by some officer of the L.A., and L.A. may refuse to register any person without such certificate of good character as they may prescribe, signed by three inhabitant householders in district rated at £6.

79 If required by L.A., the words "Registered Lodging-house" shall be kept affixed conspicuously to outside of house, under a penalty < £5 and D.P. 10*s*.

80 Every L.A. *shall* make bye-laws for—(1) fixing and varying number of lodgers in common lodging-houses, and for separation of sexes; (2) promoting cleanliness and ventilation; (3) notification and precautions in case of infectious disease; and (4) the general well-ordering of such houses.

81 When a common lodging-house is without a proper supply of water for use of lodgers, and it appears to L.A. that such could be obtained at a reasonable cost, they may require owner to provide it within a given time on pain of removal of house from register.

82 Keeper shall lime-wash walls and ceilings in first week of every October and April, to satisfaction of L.A. on pain of fine < £2.

83 Where beggars and vagrants are received, the keeper shall, if required, report in writing to L.A., or to whom they may direct, in schedules supplied by L.A., all persons lodged there in preceding day and night.

84 All keepers shall immediately report to M.O.H. and Relieving-Officer any case of fever or infectious disease.

85 All persons having or acting in management of such houses shall at all times when required by any officer of L.A. admit him to any part under a penalty < £5.

86 Failure to register house, to report lodgers in schedules supplied, or to notify when any person has "been confined to bed" [needless addition to § 84, such cases, especially small-pox, are often "ambulant"], with infectious disease involves penalty < £5, and D.P. < £2.

87 The onus of proving that any number of inmates of a house or a part thereof are members of the same family, rests on the persons alleging it.

88 After a third conviction of an offence against the provisions of this part of the Act, the Court may adjudge the offender to be for five years, or for any shorter period, disqualified from being the keeper of a lodging-

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house without the previous written license of the L.A., given on such conditions as they think fit.

89 Part of a house, if it be used as a common lodging-house, is such a house within the meaning of the Act.

Bye-laws as to Houses let in Lodgings.

	P.H.(L.)A.	
90	94	See notes.

Nuisances.

91	2	See notes. The procedure under P.H.A. is different from that under P.H.(L.)A. By § 96, the court, if satisfied, shall make order to abate nuisance and to carry out works required by L.A., and if it think fit a prohibition order against its recurrence, and may impose fine < £5, and order as to payment of costs to date. [This penalty and order are not provided for in schedules.]
(7)	24 23(4)	See notes.
92	1	,,
93	3	,,
94	4	,,
95	5 (1)	,,
96	5 (2—6)	See notes. As to payment of costs to date. [This penalty and order are not provided for in Schedules.]
97	5 (7—8)	See notes.
98	5 (9)	See notes.
99	6 (1)	See notes.
100	8	Identical.
101	9	See notes.
102	10	See notes.
103	Cf. 115	Refusal to admit officer of L.A. on order of J.P. renders offender liable to penalty < £5.
104 (1—2)	11	Identical.
(3—5)	121	,,
105	12	See notes.
106	134	Of general application in P.H.A.; applies to city only in P.H.(L.)A.; for C. of S., read "any L.A.," and omit reference to city.
107	13	Identical.
108	14	,,
109	7	,,

	SECS. P.H.(L.)A.		
110	110		Identical. P.H.(L.)A. refers to Port of London only. P.H.A. adds that "when the water is not in the district of *any* S.A., it shall be deemed to be in that of the nearest."
112	12 (1)		See notes.
113	19 (4)		,,
114	21 (1—3)		,,
115	21 (5)		,,
116	47 (1)		,, P.H.(A.)A., 28.
117	47 (2)		,,
118	47 (6)		,,
119	—		On complaint on oath by M.O.H., I. of N. or other officer of L.A., any J.P. may grant a warrant to enter any premises where he has reason to believe that any unsound food is concealed, search for, seize, and carry the same away to be dealt with under this Act; the penalty for obstruction in such case being a fine $<$ £20, in addition to any punishment for the offence itself. [This is omitted in P.H.(L.)A., which gives absolute right of entry.]
		I.D.(P.)A.	
120	60	5—6	See notes. P.H.A. enacts that on receipt of certificate of M.O.H., or any medical man, the L.A. shall give written notice to O. or *O.* to cleanse or disinfect such house, or part of house or articles *within a given time;* or failing to comply he shall be liable to penalty $>$ 1*s.* and $<$ 10*s.* per diem, and the L.A. shall do the work recovering their cost summarily. [P.H.A. does not mention *destruction* of articles.] Where the O. or *O.* is from poverty or otherwise unable to carry out the directions of the L.A., the L.A. may with his consent do so free of charge.
120	61	15—17	See notes.
121 122	59		P.H.A. is permissive only.
123	78		Identical.
124	66 (1—2)		,,
125	66 (3) 67	12	See notes.

SECS.	P.H.(L.)A.	
126	68 70	See notes.
127	70	See notes. P.H.A. does not authorize gratuitous disinfection by L.A.
128	63	Identical.
129	64	,,
*		
131	75	,,
132	76	,,
133	77	,,
*		
136	82 (1—2)	,,
137	82 (3)	,,
138	83	,,
139	84	,,
130	—	L.G.B. may from time to time make, alter, and revoke regulations for the prevention of cholera or other infectious disease, and for the treatment of the sick on land, and on rivers, and waters within three miles of the coast, and declare by what authorities they shall be executed. Such orders shall be published in the *London Gazette*, and wilful neglect, disobedience, or obstruction shall involve a penalty < £50.
134	—	Whenever any part of England is affected or threatened with any formidable epidemic or endemic disease, L.G.B. may in like manner issue regulations for—(1) the speedy interment of the dead ; (2) house to house visitation ; and (3) provision of medical aid, hospital accommodation, for cleansing, ventilation, disinfection, and otherwise preventing the spread of disease, and may by order declare such regulations to be in force in any part or district, and on all ships in any waters under H.M. jurisdiction, for such time as is stated in that or any subsequent order.
135	—	Such orders shall be published in the *London Gazette*.
140	—	Wilful violation or obstruction of such regulations renders the offender liable to a penalty < £5. [It is not clear what orders or provisions are intended by §§ 130 and 134 respectively, or

SECS.	P.H.(L.)A.	
		why there is so great a difference in the penalty. The sections seem to be redundant the special purposes mentioned in the latter being implied in the former.]
141	88	Identical.
142	82	Identical.
143	90	Identical. See notes.
144—156		These sections relating to Streets have no immediate connection with public health.
157	—	Cf. P.H.(L.)A. § 39, and P.H.(A.)A. § 23. Every U.A. *may* make bye-laws, as to (1) The width, construction, and sewerage of new streets. (2) Structure of walls, foundations, roofs, and chimneys of new houses, with reference to stability, fire, and health. (3) Surrounding air, space, and ventilation. (4) Drainage, w.c.'s, privies, ash-pits, &c., and (5) closing of buildings, or parts of such *U.H.H.* Also all provisions and regulations necessary for carrying out and enforcing the same, provided that no such bye-law apply to buildings erected before the passing of this Act, or before the place became an U.D., or subject to this enactment, by order of L.G.B., nor to buildings belonging to and used by a Railway Co. under Act of Parliament.
158	—	When an U.A. requires under its bye-laws a notice, plan, or description of any work, they shall within one month of its delivery signify in writing their approval or disapproval, and if the work be begun after notice of disapproval, or within the month without their approval, or in contravention of any bye-law, they may cause so much to be pulled down or removed, summarily recovering their expenses if any. The existence of such work after order for removal, or from its commencement if that were in violation of a bye-law, shall be deemed a continuing offence, but no penalty may be enforced after the expiration of one year.
159	—	Re-erection of a building, or of a frame-building, of which only the framework is left, above the ground-floor, or the conversion of one not intended for *H.H.* into a dwelling, or

SECS.	P.H.(L.)A.	
		of one dwelling-house into more, shall be deemed the erection of a new building.
160	—	The provisions of the Towns Improvement Clauses Act, 1847, with respect to (1) naming streets and numbering houses, (2) improving lines of streets and removing obstructions, (3) ruinous and dangerous houses, and (4) precautions during construction and repair of sewers, streets, and houses, shall be incorporated into this Act. Notices and orders under §§ 69—71, 73 and 74 of the said Act may be served on owners or on O. and *O.*: recovered in the first case from the owner, and if in the latter from the occupier, so much thereof may be deducted from the rent as with private improvements under § 214 of this Act.
164	—	U.A. may purchase (see §§ 175, 176) lease, and maintain public recreation grounds.
165	—	And provide clocks with consent of adjoining O. and *O.*
		MARKETS AND SLAUGHTER-HOUSES.
166	—	U.A. being L.B. or I.C., may with consent of owners and ratepayers (see Sch. III.), and being a town council with consent of two-thirds of their number, provide (1) market-places with all necessary conveniences, (2) purchase or lease lands and rights, tolls, &c., and (3) take rents, tolls, &c. for use of the same, provided they do not interfere with the rights and privileges of any person without his consent.
167	—	For these purposes the provisions of the Markets and Fairs Clauses Act, 1847, with respect to (1) the holding of markets, &c., (2) weighing goods and carts, and (3) rents, tolls, &c. shall be incorporated into this Act, provided that all tolls be approved by L.G.B.: and U.A. may make bye-laws for the regulation of the markets as under § 42 of the said Act, printed notices of which shall be exhibited in the market.
168	—	Authorizes and regulates the sale of market rights by any company to U.A.

SECS.	P.H.(L.)A.	
169	—	Any U.A. *may*, if they think fit, provide slaughter-houses, and *shall* make bye-laws for the management and charges for the use of the same; for this purpose the provisions of the Towns Improvement Clauses Act, 1847, shall be incorporated into this Act. Nothing in this section shall prejudice the privileges of any persons incorporated by any local Act for the establishment of slaughter-houses prior to the P.H.A., 1848.
170	—	The O. or *O.* of any slaughter-house licensed or registered under this Act shall within one month affix and keep conspicuously thereon the words "Licensed" or "Registered Slaughter-house," under a penalty < £5, and D.P. 10*s.*
171	—	Police regulations.
172	—	,, ,,
173	—	Contracts.
175 to 178	—	Purchase of lands.
179 to 181	—	Arbitration.
182	—	Bye-laws made by L.A. must be under their common seal, may be revoked or altered, but must not be repugnant to the laws of the realm or the provisions of this Act.
183	—	Penalties may be imposed on their violation < £5, and D.P. £2, provided that a lesser sum may always be recovered, and the penalty must never exceed that imposed by this Act for any particular offence.
184	—	They must be confirmed by L.G.B., which may refuse approval of the same, unless (1) at least one month's notice of intention to apply for confirmation have been given in local newspapers, and (2) a copy have been kept at the office open to inspection of ratepayers for the same period. Any ratepayer shall be entitled to a copy on payment of sixpence for every hundred words. No confirmation other than that of L.G.B. shall be required.
185	—	All bye-laws shall be printed and a copy hung up in the office of the Board, and given on application to any ratepayer. Those made by R.A. shall be sent to the overseers of every

SECS.	P.H.(L.)A.	
		parish to be kept among the parish documents open to inspection of ratepayers.
186	—	A copy certified to be true by the clerk of any L.A. (not being a Borough Council) shall be evidence in courts of law.
187	—	Bye-laws made by a borough council under 5 & 6 W. 4. c. 76, § 90 to be confirmed by L.G.B., not S.S.
188	—	These provisions shall not apply to other regulations than a L.A. is by this Act authorized to make, and which they may publish as they think fit.
189	106 107	Officers of U.A.
190	—	,, ,, R.A.
191	108(1) 109	See notes in P.H.(L.)A.
192	—	The same person may be surveyor and inspector of nuisances. * * * *
193	—	No officer or servant of L.A. may enter into any contract with L.A., or accept fee or reward other than his salary, on pain of forfeiting £50 and costs, recoverable by any person, and becoming incapable of holding any appointment under this Act (but no proceedings to be taken without consent in writing of Attorney-General.—P.H. (Memb. & Off.) A., 1884).
194	—	Officers intrusted with money to give security.
195	—	Officers to give account of moneys received.
196	—	Summary proceedings may be taken against any officer failing to give such account, or to hand over on demand within five days all books, papers, or property relating to the execution of the Act or belonging to the L.A.
		* * * * *
197 to 205	—	Relate to mode of conducting business.
206	—	Every L.A. shall make an annual report in such form and at such time as the L.G.B. may direct, of all works executed and sums received and expended, and send a copy to L.G.B. An U.A. shall also publish it in local paper.
207 to 250	—	Rating and borrowing powers.

LEGAL PROCEEDINGS.

SECS.	P.H.(L.)A.	
251	—	The C.S.J., before which complaints are to be made, prosecutions instituted, and moneys recovered summarily, shall be two or more J.P.s sitting in P.S., or some one magistrate empowered to act alone in like manner.
252	—	All complaints or informations must be made within six months of the cause.
253	—	Proceedings for recovery of any penalty shall not, except when expressly provided, and in respect of §§ 108 and 115, be taken by others than the persons aggrieved, or by the L.A. of the district in which the offence occurs, without consent in writing of the Attorney-General.
254	—	When not otherwise provided, half of the penalty shall go to the informer and half to the L.A., or when the L.A. is the prosecutor they shall receive the whole.
255	120	Identical.
256	—	Recovery of rates from defaulter.
257	—	Recovery of expenses by L.A. from owners.
258	122	Identical.
259	123	,,
260	—	Name of L.A. need not be proved.
261	—	Demands below £50 may be recovered in County Court.
262	—	Proceedings shall not be quashed for want of form, or be removed into any superior Court save for opinion.
263	—	False evidence shall be punished as perjury.
264	—	No action shall be taken against L.A., their members, officers, &c., on any matter in this Act, except after a clear month's notice of subject of complaint, plaintiff's attorney, &c., and the action shall be tried within six months of the cause, and in the same county. (The remainder of the section refers to money paid into court, &c.)
265	124	Identical.
266	127	,,
267	128	See notes.
268	—	Any person aggrieved by decision of L.A. in a matter involving summary recovery of expenses may within 21 days appeal to L.G.B., giving notice to L.A., such notice suspending

SECS.	P. H. (L.) A.	
		any action pending. L.G.B. may make an order final and binding, and may award compensation.
269	125	See notes.
270 to 275	—	Alteration of areas and union of districts.
276	—	L.G.B. may conditionally or unconditionally, on request of a R.A., or of one-tenth in value of the ratepayers, invest R.A. with all powers of an U.A. for the district, or for a C.P. only.
277	—	A R.A. may by resolution approved by L.G.B. constitute any part of its district a special "drainage district" chargeable for the expenses of such works.
278	—	L.G.B. shall decide disputes as to boundary of U.D. after local enquiry, if necessary.
279 to 285	—	Union of districts for obtaining common water supply, for main sewerage, &c.
286	—	L.G.B. may unite two or more S.D. wholly or partially in the same county (except U.S.D. with pop. of 25,000, or boroughs having separate C.Q.S., unless they consent), for the purpose of appointing M.O.H., and may make regulations as to salary, tenure, duties, &c., and apportion expenses among several districts; and no other M.O.H. shall be appointed in the districts except as assistant, &c. Notice of proposed inclusion of a district must be given to its L.A. 28 days before application, and if objection be raised within 21 days, L.G.B. may include it only by a provisional order.
287 to 292	112	Regulate the constitution and powers of P.S.A.
293 294 295 296	129	L.G.B. may order local enquiries on any matter affecting the public health, or into the expenses of enquiries, appeals, &c. Such orders shall be binding and conclusive, and the inspectors of L.G.B. shall for the purpose of these enquiries have all the powers of Poor Law inspectors, viz., taking evidence on oath or written attestation, requiring productions of papers and accounts, and inspecting places and things, but no witness can be compelled to come more than 10 miles.

SECS.	P.H.(L.)A.	
297 298	—	Relate to P.O.s of L.G.B.
299 to 302	101	The same, but as regards the city of London see § 135.
303	—	L.G.B. may by P.O. repeal or alter Local Acts.
304	—	L.G.B. empowered to settle differences arising out of transfer of powers or property to L.A.
305	115	See notes.
306 307	116	The same.
308	—	L.A. shall award full compensation for injury caused by any act of theirs to any person not himself in fault, to be settled by arbitration, or if the amount claimed do not exceed £20, to be determined by and recoverable in a C.S.J., at the option of either party.
309	—	L.G.B. may award compensation to any person acting under previous sanitary, local, or L.G. Acts, who may by this Act or any P.O. be deprived of his office without being appointed to another of equal value.
310	—	Whenever an Impr. Act District or L.G.D. is constituted or included in a borough, all the powers, rights, duties, liabilities, and property of the Commissioners shall be transferred to and vested in the Council of the Borough.
311	—	Any L.B. may with sanction of L.G.B. change its name without prejudice to legal proceedings already commenced.
312	—	Regulates election of certain Imp. Comm.
313	—	When in any Act, order, or document any provisions of a Sanitary Act repealed by this are mentioned, such provisions shall be read as if incorporated into this Act, subject to any modification or restriction mentioned in such Act or order.
314	—	L.A. may make bye-laws for decent lodging and accommodation of hop-pickers.
315	—	Any bye-law of a L.A. so far as it is inconsistent with this Act shall be void.
316	—	In the construction of provisions of any act incorporated herein, "the special Act" shall mean this Act, and in the case of the Land Clauses Consol. Acts of 1845, 1860, and 1869,

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P.H.(L.)A.

any order confirmed by Parliament for purchase of lands otherwise than by agreement; the term "limits of the special Act" shall mean the S.D., and the L.A. shall be the "promoters," "commissioners," &c. All penalties under incorporated Acts shall be recoverable and applied as under this.

317 — The Schedules shall be deemed parts of this Act, and the forms in Sch. IV., or others to the like effect, varied according to circumstances, may be used and shall be sufficient for all purposes.

318 to 325 — Temporary provisions.

326 — All existing U. and R.S.D. and A., their members, officers, and bye-laws (so far as these are not inconsistent with this Act), shall continue and be deemed to be constituted and authorized hereby.

327 136 See notes. Nothing in this Act shall authorize L.A. to interfere with—

(1) Sluices, groynes, sea-walls, &c. for preserving or draining, improving or irrigating lands, and constructed by commissioners or under private acts.

(2) Land or property vested in the Admiralty.

(3) The traffic or navigation of any river, canal, dock, harbour, basin, &c., authorized by Act of Parliament.

(4) Any water-course supplying the same otherwise protected by law.

(5) Any bridges used by or on which such persons are legally entitled to levy tolls.

(6) Or authorize L.A. to execute works in or through such harbours, docks, &c., &c., without the consent in writing, and under the seal or signature of such persons respectively.

(7) Or prejudice the rights, powers, &c. of such persons, of preserving, improving, draining, &c. such land or property.

328 A L.A. contemplating any works not provided for in the preceding section, but likely to have an injurious effect on any such property, shall give notice of their intention to the parties concerned. If they object

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the matter shall be referred to arbitration as respects—(1) the injury, if any, likely to be caused; and (2) whether it can be fully compensated by payment of money.

329 If arbitrators decide—that (1) no injury will be caused, L.A. may proceed with the work; or (2) it is capable of full compensation by money, they shall assess damages to be paid by L.A.; but if (3) they deem it not so to be fully compensated, L.A. shall desist therefrom.

330 No transfer of powers, &c. shall affect rights of navigation, &c.

331 Commissioners, &c. of docks, canals, &c. may take up, divert, and replace by others equally efficient, and certified as such by surveyor of L.A., any drains, sewers, &c. of the L.A. interfering with their property, but shall do so and make good all damage at their own expense.

332 Nothing in this Act shall authorize any interference with or injury to water rights in general.

333 Any disputes to be settled by arbitration as provided in § 329.

334 Nothing under this Act shall interfere with or affect injuriously any mining or smelting works, &c.

335 The powers and obligations set forth in the Sewage Utilization Act, 1867, shall apply to Government departments, and to any collegiate or corporate body authorized or required by Act of Parliament to divert its sewers from a river or to construct others, the corresponding provisions of this Act being substituted for those in the former Act.

336 Nothing in this Act shall affect the outfall or other works of the M.B.W.[= L.C.C.]

337 Nothing in this Act shall affect the payments or recovery of any yearly sum payable in pursuance of L.G.A. (1858) Am. Act, 1861, to any L.A., in respect of premises outside of their district having a drain connected with a sewer of the L.A., so long as such connection exists, or in the event of its being restored.

338 Rates, acts, &c. of a L.A. lawfully made or done prior to passing of this Act shall remain valid.

339 Nothing in this Act shall affect constitution, &c. of any local board under O.C., or Prov.O. under P.H.A., 1848, confirmed by Parliament, but any such order may be repealed or amended as provided in this Act.

340 Where a local act for like purposes is in force, proceedings may be instituted under it, or this or both,

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provided that—(1) no person be punished under both, and that (2) L.A. shall not, in virtue of local Act, be exempted from any objections imposed by this.

341 All powers given by this Act shall be cumulative, and in addition those otherwise possessed; and this shall not exempt any one from penalties incurred under other Acts, but no one shall be punished for same offence under both.

342 Constitution of L.A. of Oxford.

343 For Acts and parts of Acts repealed, see Sch. V. So much as is not repealed is re-enacted as if it were part of this Act. Such repeal shall not, however, affect (*a*) anything duly done or suffered; (*b*) any right acquired or liability incurred; (*c*) any security given (*d*) or penalty incurred under the Acts repealed; nor (*e*) any enquiry, legal proceeding, or remedy in respect of any of the above which may be carried on as if this Act had not been passed.

Schedule I. Rules as to meetings and proceedings of Boards.

Schedule II. Rules for election of Local Boards.

Schedule III. Rules as to resolutions of meetings of owners and rate-payers.

Schedule IV. Forms. See Appendix.

Schedule V. Acts and parts of Acts repealed by P.H.A. 1875; and P.H.(L.)A. 1891.

NOTES ON P.H.(L.)A. AND P.H.A. 1875,

WITH COLLATION OF CORRESPONDING SECTIONS.

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P.H.(L.)A.	P.H.A. '75.	
1	92	“Duty.” If neglected L.A. may be compelled to perform their duty by §§ 106 & 299 P.H.A. = 134 (City), 100 & 101 P.H.(L.)A. “Inspect.” No right of entry without order of J.P. See §§ 98 v. 102 P.H.A. = 10 & 5 P.H.(L.)A. See also § 40 P.H.(L.)A. P.H.A. adds “also to enforce provisions of any local Smoke Abatement Act.”
2	91	P.H.A. does not add “or dangerous.” It is (in London) not necessary to prove *injury* to health, nor even that it be felt as an annoyance, *i. e.* nuisance; it is sufficient that

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P.H.(L.)A.	P.H.A. '75.	
		there is a danger, *i. e.* a possibility of such injury.
2 (1) †	—	This refers only to the metropolis.
	subs. 7	Smoke clause of P.H.A. = § 24, P.H.(L.)A.
3	93	P.H.A. authorized "any person *aggrieved* thereby, or any two *householders in the district*, or any officer," &c. P.H.(L.)A. gives the right to *any one* unconditionally, and makes it the *duty* of the officers of L.A. and poor-law, and of the S.A. to serve notices on the persons answerable for it.
4	94	Subs. 2, *re* preventive works; subs. 3, *c.* report of M.O.H. on overcrowding, and *d.* on water-fittings under M.W.A., are new, and not in P.H.A.
5 (1)	95	P.H.A. simply provides that if the nuisance be not abated, or be likely to recur, the S.A. *shall* complain to a J.P., who *shall* summon tho defaulter to appear before a C.S.J.
(2—5)	Cf. 96	These subs. are new, procedure of P.H.A. different.
(6—8)	97	P.H.A. If satisfied that a house is *U.H.H.*, the court may (shall ?) prohibit its further occupation until satisfied that it has been rendered fit.
(9)	98	The penalties of 20*s.* and 40*s.* in P.H.(L.)A., are 10*s.* and 20*s.* in P.H.A.
6 (1)	99	P.H.(L.)A., "or abandonment of such appeal." P.H.A., "unless such appeal ceases to be prosecuted,"—an ambiguous expression.
(2—4)	—	These subs. of P.H.(L.)A. are new, not in P.H.A.
7	109	P.S.C. in P.H.(L.)A. is C.S.J. in P.H.A.
8	100	Identical.
9	101	P.H.A. mentions sale by public

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P.H.(L.)A.	P.H.A. '75.	
		auction only, except of filth, see § 49 P.H.A.
10	102	P.H.A. adds for enforcing provisions of Local Smoke Abatement Acts.
11	104	§ 104 P.H.A. includes also 121 P.H.(L.)A.
12	105	P.H.A. enacts the same limitations as to persons qualified to complain as § 93. See § 3, P.H.(L.)A.
13	107	P.H.A. for Superior Court of Law or Equity now read High Court.
14	108	Identical.
15	—	This sec. is new, not in P.H.A.
16	44	In P.H.A., L.A. *may* make bye-laws imposing on householders duty of cleansing footways and pavements, earth-closets, privies, cesspools, and ashpits, and of removing house refuse when they do not themselves undertake or contract for the same, and *may* make bye-laws for prevention of nuisances from accumulation of snow, filth, ashes, &c., and from keeping animals. The rest of § 16 P.H.(L.)A. is new.
17	47 (1)	P.H.A. prohibits only keeping swine in dwelling-house or so as to be a nuisance within U.D.; but also
	(2)	suffering stagnant water to lie in cellar or dwelling-house 24 hours after written notice from U.S.A.,
	(3)	and allowing contents of w.c., privy, or cesspool to overflow or soak out, on penalty < 40*s.* and D.P. < 5*s.* after notice, and authorizes the abatement of the nuisance by S.A. at the expense of the occupier.
18	—	New, except as far as met by 91 (3).
19 (1)	112	P.H.A. applies to U.D., empowers S.A. to sanction *any* of these trades, and imposes D.P. < 40*s.* [not £50] for non-compliance with P.O.
(2)—(3)	—	New.

SECS.		
P.H.(L.)A.	P.H.A. '75.	
(4)	113	Practically identical, but substituting U.A. for C.C.
(6)—(10)	—	New.
20	—	New.
21 (1)—(3)	114	P.H.A. mentions some, viz., candles, soap, blood-boiling, bone-boiling, &c., works, or *any* causing effluvia; it does not add "or dangerous," and imposes different penalties, viz., $>$ £2 and $<$ £5 for first offence, and double the preceding fine for each succeeding conviction, but never $>$ £200.
(4)	—	New.
(5)	115	The P.H.A. clause is, as hitherto, to extend to London. See Sched. I. It reads—"When any house, factory, &c., certified to be a nuisance or injurious to the health of persons within an U.D. is situated outside of the same, the S.A. may take or cause to be taken the usual proceedings (sec. 114) before a C.S.J. having jurisdiction in the district in which the nuisance is situated."
22	—	New.
23 (4)	91 (7)	P.H.L.A. 23 (1-3 and 5-8) is new.
24	91 (7)	Secs. 24 and 23 (4) are taken from 91 (7) of P.H.A.
25	—	New.
26	—	Incorporates *quo ad* bake-houses, F.W.A. 1878, §§ 34, 35 & 81, and F.W.A. 1883, §§ 15 & 16. *q.v.*
27	—	New.
28	—	The matters mentioned in subs. 1 are the same in sec. 13 of "Dairies, Cowsheds, and Milkshops" Order of 1885, respecting regulation of L.A.
29	—	New.
30 (1)	42	P.H.A. is less exacting. Every L.A. may, and when required by L.G.B., shall undertake or contract for removal of house refuse and cleaning of privies, ash-pits, &c., and when invested with requisite powers

SECS.		
P.H.(L.)A.	P.H.A. '75.	
		for the cleaning of streets, they may also for the watering of the same.
32	,,	All refuse so collected shall be the property of the L.A., to be sold or otherwise disposed of, any profits to be applied to the expenses of executing these provisions of the Act in U. and R.D. respectively. See for U.D. sec. 209 & p.p. and R.D. secs. 229, 230. Any person obstructing removal to be liable to a penalty $<$ £5, except as regards refuse, &c., which the occupier intends to employ for his own use unless he meanwhile suffer it to become a nuisance.
30 (2—3)	—	New.
31	—	New.
33	—	New.
34	43	These clauses do not exactly correspond. The P.H.A. enacts that in case of neglect of L.A., without reasonable excuse, to remove any refuse from premises, privies, ash-pits, &c., within seven days of receiving a remonstrance from the occupier, they shall be liable to pay him 5*s.* for each further day's neglect. By P.H.(L.)A. secs. 30 (2) and 34, the S.A. is liable to a fine $<$ £20, and the occupier may dispose of the refuse as he likes.
35	49	P.H.A. within 24 hours, P.H.(L.)A. in 48.
36 (1)	—	(1) is new.
(2)	50	P.H.A. contains the phrase "or permits further accumulation."
37 (1—2)	35	P.H.A. merely states "sufficient w.c., e.c., or p., and an a.p., furnished with proper doors or coverings."
(3—4 (*b*))	36	The P.H.A. does not provide for a fine, but makes the work done by L.A. a P.I.E. summarily recoverable.
(4 (*a*) 5)	—	These subs. are new.
38	38	By P.H.A. L.A. *may* require such provision of w.c., e.c., or ash-pits, only

SECS.		
P.H.(L.)A.	P.H.A. '75.	
		when persons of both sexes are employed there. The penalty for non-compliance is the same.
39	—	New, except that P.H.A. 157 (4) L.A. may make bye-laws as to drainage, w.c., privies, cesspools, &c.
40 41	40 41	These sections correspond, but with important differences.
	40	Every L.A. *shall* provide that all w.c., e.c., p., c.p., a.p., and drains be so constructed and kept as not to be a nuisance or injurious to health.
	41	On written complaint of *any* person that any drain, w.c., &c., is a nuisance, &c., L.A. *may* empower surveyor or S.I., after 24 hours' notice to occupier, to enter with or without assistants, or in emergency without notice, to open ground, &c. If found in proper order they shall make good the damage, but if bad L.A. *shall* give notice to O. or *O.* to execute specified work forthwith or within a reasonable time, on pain of a D.P. < 10*s*., or L.A. may do the work, recovering the cost on declaring it a P.I.E.
42	—	New clause.
43	— Cf. 91 (2) 48	New clause. Offensive ditches are nuisances under the P.H.A. 91 (2), which L.A. may require private persons to abate, and sec. 48, which relates to such on boundary between two districts or beyond such boundary and empowers L.A. to complain to J.P. in the other district to call on the other L.A. to show cause why they should not abate or cause the nuisance to be abated, in which case the court may direct the apportionment of the costs.
44	39	P.H.A. merely empowers L.A. to erect public conveniences in suitable places, but makes no mention of

SECS.		
P.H.(L.)A.	P.H.A. '75.	
		lavatories or water supply, though w.c.'s imply such supply.
45	—	New, save as implied in powers as to bye-laws and in sec. 39.
46	—	New clause, save as common nuisances for which several persons are jointly responsible.
47 (1) See also P.H.(A.)A. § 28.	116	P.H.A. does not authorize entry save by implication in penalty for obstruction and sec. 119. [Sunday is not an unreasonable time. The M.O.H. or S.I. must not himself destroy it.] P.H.A. enumerates any "animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, or milk," but omits eggs, cheese, &c. P.H.(L.)A. states "any (*a*) animal, or (*b*) article solid or liquid." [A J.P. was unable to condemn a chest of rotten eggs since they were not poultry !]
(2) (7)	117	The two Acts differ in the enumeration of foods as in Sec. 116 P.H.A., and in the penalty, P.H.A. allowing £20, and three months only and not hard labour.
(6)	118	P.H.A. does not mention previous conviction, and imposes a penalty > £5.
(3) (4) (5) (8)	—	New sub-sections.
—	119	Omitted in P.H.(L.)A., M.O.H., or S.I., having absolute right of entry.
48	—	New clause.
49	—	New clause.
50	—	New clause.
51	64	P.H.A. practically the same, but does not mention "fountains," specifies that the water shall not be sold by any person, and does not provide for wilful damage.
52	68	Identical.
53	—	New clause.
54	70	Identical, except that P.H.A. omits "dangerous."

NOTIFICATION OF INFECTIOUS DISEASES.

SECS.		
P.H.(L.)A.	I.D.(N.)A.	
55 (1—2)	3	Identical.
(3)	4 (1—2)	,,
(4)	10	Applies to London only.
(5)	4 (3)	Identical.
(6)	—	New.
(7)	13—15	Identical.
(8)	6	,,
56 (1—6)	7	,,
(7)	—	Refers to London only.
57	11	Identical.

The following clauses of I.D.(N.)A. are not incorporated into P.H.(L.)A.

[By sec. 5 the adoption of this Act was *optional*, and consistent with the retention of more stringent Local Acts. But by I.D.(N.) Extension Act, 1899, it is made compulsory everywhere: and in Scotland by P.H.(S.)A. 1897, § 44.]

8 Notices may be printed, written, or both, and delivered at or posted to house or office of M.O.H.

9 Expenses to be paid as for other P.H., or in R.D., as general expenses.

12 This Act shall apply to Woolwich as if the L.B. were a London Vestry, and it shall appoint a M.O.H.

[It shall supersede like provisions of any local Act, except that of Huddersfield.]

16 Definitions as in other P.H.A.s.

17—18 Substitution of terms required in applying the Act to Scotland and Ireland.

Prevention of Infectious Diseases

SECS.

P.H.(L.)A.	P.H.(A.)A.	I.D.(P.)A.	P.H.A.	
58	—	—	—	
59	—	—	121 122	P.H.A. is simply permissive, "may provide—direct—give, &c."
60	—	5	120	Where adopted I.D.(P.)A. § 5 repeals P.H.A. § 120, which reads, "Where the *L.A. are of opinion* on the certificate of the M.O.H. or of, &c.," thus leaving the L.A. at liberty to ignore medical opinion; the notice is to be served on the "owner *or* occupier," probably as is most convenient. [Since there is no demand for an expression of his *intention* to comply, much valuable time may be lost.] Failure to comply renders him liable to a D.P. of from 1*s.* to 10*s.* after notice. L.A. may summarily recover expenses, or in case of poverty or other circumstances may disinfect gratuitously. Compare § 308, under which, when a person "sustains damage through the working of this Act in a matter in which he is not himself in default," he may be compensated to an amount $<$ £20.
(3)	—	17	—	I.D.(P.)A. § 17, the officer of L.A. producing his authority in writing may enter between 10 a.m. and 6 p.m.
(4)	—	4	—	Identical.
61	—	6	—	I.D.(P.)A. § 6. L.A. "or the M.O.H. generally empowered by the L.A. in that behalf."
62 (1)	—	13	—	I.D.(P.)A. § 13. "Any person knowingly . . . without previous disinfection, shall be guilty of an offence

SECS.				
P.H.(L.)A.	P.H.(A.)A.	I.D.(P.)A.	P.H.A.	
				under this Act." *For penalty* see § 16.
(2)	—	—	—	New clause.
63	—	—	128	
64	—	—	129	
65 (1)	—	7	—	
(2)	—	14	—	I.D.(P.)A. § 14. "Where §§ 7 or 13 are in force, L.A. shall give written notice thereof to the occupier of any house in which they are aware that a person is suffering from infectious disease."
66 (1, 2)	—	—	124	
(3)	—	—	125 ?	In P.H.A. § 125 the regulations of L.A. which must be approved by L.G.B. apply only [why ?] to persons "brought within their district by a *ship or other vessel.*"
67	—	12	—	These new §§ for the first time recognize "*preventing the spread of the disease*" as a reason for detention. [P.H.A. § 124 relates only to the well-being of the individual, so that a man on a sick club, or the child of one in receipt of good wages, cannot be removed even if the house be full of children and susceptible persons, since the actual patient cannot be said in the legal sense to be "without proper lodging and accommodation," though isolation be impracticable.]
68	—	—	126	
69	—	—	—	New clause.
70	—	—	126 127	P.H.A. § 126 (1) covers this to some extent, simply enacting that such a person "entering a public conveyance without previously notifying to the owner, conductor,

SECS.				
P.H.(L.)A.	P.H.(A.)A.	I.D.(P.)A.	P.H.A.	
				or driver that he is so suffering," shall be liable to a fine < £5, and "to pay the owner and driver the amount of any loss or expense he may incur by § 127, which requires him, on pain of a fine < £5, to disinfect the vehicle [how it does not say !], though he may refuse to convey such person until he have been so paid for the consequences. [There is no provision for gratuitous and official disinfection.]
71 (1–5)	—	4	—	[Two grave defects in this clause as it stands in each Act are, (1) that the M.O.H. must after inspecting the dairy prove that disease has actually been caused thereby, thus neglecting the "prevention of disease" recognized in the new phrase of "a nuisance or injurious or *dangerous* to health," so that he could not close a dairy at which diphtheria or scarlatina existed before the disease had extended to the consumers; and (2) that the sale of the condemned milk is permitted anywhere except in the particular district. [The first is probably an inadvertence, and the words "likely to be caused" might be read in from above, but the second is plain enough. Milk conclusively shown to have spread disease in one district may and will be sold in another, and will in most cases be sent to London. The words "within the district" should be omitted.]

SECS.				
P.H.(L.)A.	P.H.(A.)A.	I.D.(P.)A.	P.H.A.	
72	—	8	—	I.D.(P.)A. § 8 inserts the superfluous word "mortuary."
73	—	9	—	Identical.
74	—	11	—	I.D.(P).A. § 11. "Shall be guilty of an offence under this Act." For penalty see § 16.

Provisions peculiar to I.D.(P.)A.

3 The Act *shall extend* (1) *to every London district*, and (2) to any U. or R.D. after its adoption. Any U. or R.S.A. *may* adopt all or any sections, by resolution of which fourteen clear days' notice has been given; the resolution, when carried, to be advertised in local papers, published by handbills, posters, or otherwise: and shall come into operation not less than one month afterwards.

A copy of resolution to be sent to L.G.B., and no objection on ground of insufficient publication can be raised after three months.

10 When any dead body is retained in any building so as to endanger health of inmates of the same or other houses, &c., and when one dead of any I.D. remains unburied for forty-eight hours after death in any dwelling or work place, without sanction of M.O.H. or medical practitioner, a J.P. may, on application of M.O.H., order its immediate removal to any mortuary at cost of L.A., and its burial within a limited time, or in infectious or urgent cases forthwith. If friends or relatives do not,

SEC. I.D.P.A.	
	the Relieving Officer of the district where the body was found shall bury it, charging for his expenses the L.A., who may recover summarily from the responsible persons.
16	Penalty for obstruction and for any offence under this Act, for which none is specified, shall be a fine < £5, with, if a continuing offence, a D.P. < £2.
18	Penalties recoverable in C.S.J. on information or complaint of L.A. or duly authorized officer.
19	If adopted in any district its provisions shall supersede like provisions of local Acts.
20	Expenses to be defrayed as other P.H. expenses, including reasonable fees of Vet. Insp. or Surg. under § 4.
21	The resolution adopting the Act may be rescinded after like notice and procedure.

P.H.(L.)A.	P.H.A.	
75	131	Identical.
76	132	,,
77	133	,,
78	123	,,
79	—	New.
80	—	,,
81	—	,,
82 (1, 2)	136	Identical.
(3)	137	,,
83	138	,,
84	139	,,
85	—	New.
86	—	,,
87	—	,,
88	141	Identical.
89	142	,,
90	143	,, [“Mortuary” includes, not only the dead-house, but also post-mortem

SECS.		
P.H.(L.)A.	P.H.A.	
		room, &c. The place for the reception of the dead should therefore be apart from other rooms and offices.]
91	—	New.
92	—	,,
93	—	,,
94	90	Identical.
95	—	New.
96	72	The London Act contains several provisions not in P.H.A. Thus (*a*) "Provided that . . . six feet," (*b*), (*c*), (*d*), (*f*), (*g*), and (*i*), 3, 4, 5, 6, are new and (*k*) is rewritten. In P.H.A. the area need only be 2½ not 4 feet wide, but there must be "a space of 6 inches between every part of the steps leading down to the cellar and the wall thereof." [This is rendered unnecessary by the greater width now required.] The only provision as to drainage is "that it be effectually drained by a drain, the uppermost part of which is at least one foot below the level of the floor ; and the clause in P.H.A. corresponding to (*k*) in P.H.(L.)A. reads, "an external window of at least nine superficial feet in area clear of the sash frame, made to open in a manner approved by the Surveyor (except in the case of an inner or back cellar let or occupied along with the front cellar as part of the same letting or occupation, in which the external window may be of any dimension, not being less than four superficial feet clear of the sash frame)." The P.H.A. uses the term "cellar" in place of "underground room."
96 (2)	73	
(7, 8)	74	P.H.A. § 74. "Any cellar in which any person passes the night shall be deemed to be occupied as a dwelling within the meaning of the Act."
97	—	New.
98	75	Identical.
99	—	New.
100	—	A new authority, the C.C., is here introduced.

SECS.		
P.H.(L.)A.	P.H.A.	
101 (1, 2)	*Cf.* 299	Under P.H.A., any person may make complaint to L.G.B. of default of L.A., and the L.G.B. may appoint "some person" to perform the duty. This person, whom the L.G.B. "may change from time to time," shall receive "reasonable remuneration," recoverable together with all costs of proceedings in King's Bench, and is to "enjoy all powers of L.A. save as to levying rates."
(3–6)	—	New.
102	—	,,
103	—	,,
104	—	,,
105	—	,,
105	*Cf.* 189	P.H.A. § 189 enacts that every U.A. shall appoint fit and proper persons as M.O.H., surveyor, inspectors, clerk, and treasurer, with such assistant officers as they deem necessary, and, save when part of their salaries is paid by Treasury, on such conditions, &c., of salary, duties, and tenure, as they think fit.
—	190	R.A. shall appoint M.O.H. and I.N.s, also such other officers as may be necessary; those of the Union being eligible at some additional remuneration.
106	191	The provision as to residence is new.
107	—	The title S.I. in place of I.N. is new, as are all the provisions as to duties and complaints.
108 (1)	191	P.H.(L.)A. § 108 (1) is contained in P.H.A., but the rest of the section is new. At the passing of P.H.A., 1875, there were no D.P.H., and appointments were open to all men "legally qualified to practice medicine, surgery, and midwifery," or who were at least "registered practitioners."
—	191	The P.H.A. provides that L.G.B. may prescribe *duties* in all cases, though tenure and salary only when paying part; also declares Poor Law surgeons eligible, and that the same person may be appointed M.O.H. for two or more dis-

SECS.		
P.H.(L.)A.	P.H.A.	
		tricts, or even be M.O.H. and I.N., with the sanction of the L.G.B.
109	191 (last clause.)	P.H.A. §191 permits the appointment of deputy M.O.H. in case of illness or incapacity of M.O.H., subject to approval of L.G.B.
110	110	P.H.A. of general application. See note *in loco.*
111	—	New.
112	—	,,
113	—	,,
114	—	,,
115	*Cf.* 305	P.H.A. When it is necessary for officers of L.A. to enter, examine, or lay open any premises or land for making plans, surveying, &c., examining or repairing works, ascertaining course of drains or sewers, or for fixing boundaries, and the owner or occupier refuse, the L.A. may, after written notice to the owner or occupier, apply to C.S.J. for entry order. If no sufficient cause be shown to the contrary, C.S.J. may make the order and L.A. enter between 10 a.m. and 6 p.m., but except in cases of urgency, only after 24 hours' written notice. See also §§ 98, 102, 106, and 116.
116	306-7	Identical.
118	—	New.
119	—	,,
120	255	Identical.
121	104	P.H.(L.)A. includes also § 11 P.H.A.
122	258	The same, save that P.H.(L.)A. adds "judge."
123	259	Identical.
124	265	,,
125	269	The same in its statement, but new Act substitutes the words "as otherwise provided in this Act" for the seven clauses of P.H.A., explaining the conditions of appeals,

SECS.		
P.H.(L.)A.	P.H.A.	
		viz. (1) Appeal to be made to next C.Q.S., held not less than 21 days after demand or decision, and (2) within 14 days of cause appellant to give notice of his intention to other party and to L.A. or court by whom he feels himself aggrieved, (3) immediately thereafter entering, with two sureties, into a recognizance before a J.P. of Court personally competent to try appeal, to abide by its decision, or to give such money or other security as J.P. may allow ; and on such recognizance or security (4) if appellant be in custody the J.P. may release him. (5) Court may exercise its powers of amending or quashing any rate or assessment, granting and awarding costs, appeals, recoverable as in other cases in the court. Provided that, when a rate has been quashed all moneys charged thereby shall, if court so decide, be levied notwithstanding and taken as payment on account of the next effective rate for the same purposes. (6) In other cases the court may adjourn the appeal, and then confirm or reverse judgment of C.S.J., or remit the case thereto with the opinion of the Court of Appeal thereon. It may also make order as to payment of costs by each party. (7) Decision of Court of Appeal shall be binding, provided that the court may state the facts for determination of a Superior Court.
127	266	Identical.
128	267	The same, except that P.H.A. adds that for proof of serving by post "it shall be sufficient to prove that the notice was properly addressed and sent by post" [*i.e.* practically, by registered letter].

SECS.		
P.H.(L.)A.	P.H.A.	
129	293 to 296	Incorporates these §§ of P.H.A. in respect of inquiries by L.G.B.
130	—	Forms to be employed.
131	—	New.
132	—	”
133	—	”
134	106	P.H.(L.)A. applies only to City; P.H.A. to any defaulting authority.
135	—	” ” ”
(1—2)	299	” ” ”
(3—4)	300	” ” ”
(5—6)	301	” ” ”
(7—9)	302	” ” ”
136 137 138	Cf. 327 and sqq.	See P.H.A. § 327 and sqq.

HOUSING OF THE WORKING CLASSES ACT, 1890.

Repeals all like Acts from 1851, except §§ 3, 7, 8 and 9 of H.W.A. of 1885.

Part I. supersedes Cross's Acts 1875 and sqq., and applies to U.S.D. only. II. Torrens' Acts 1868 and sqq. III. Shaftesbury's and other Acts 1851 and sqq. IV. is supplementary; V. relates to Scotland; VI. to Ireland; and VII. is provisional and explanatory, and contains forms and schedules.

Sched. I. (Cfr. §§ 54 and 92) defines L.A. In London without the city the L.C.C. for Parts I. & III.; the vestries and Local Boards for II. In the city the Commissioners of Sewers, and elsewhere the U. & R.S.A. under P.H.A. 1875 for all purposes.

PART I. UNHEALTHY AREAS.

Sec. 3. Defines O.R. as one made to the L.A. by their M.O.H., or in London by the M.O.H. of any S.D. in London.

Sec. 4. The L.A. *shall* consider an O.R. that any houses, streets, &c., within a certain area are "unfit for human habitation," or that the sanitary conditions, want of air or light, or other defects, are such as to be "injurious or dangerous to the health of the inhabitants of these or of other houses," and cannot be remedied except by the "rearrangement or reconstruction of the houses," and "if satisfied as to the truth thereof," and "of the sufficiency of their resources," *shall* forthwith make a scheme for the improvement of such area or areas.

Sec. 5. The M.O.H. shall make such O.R. whenever he sees cause; and when two J.P.s or twelve ratepayers in the district complain to him he *shall* inspect the area and report as to the facts to the L.A., with his opinion whether it is an *U.A.* or not.

Sec. 6. The I.S. *shall* be accompanied by maps, estimates, &c., distinguish lands proposed to be taken compulsorily, and provide accommodation (sec. 11) for displaced families with proper sanitary arrangements. It *may* vary the area by exclusion or inclusion, widen streets or make new ones, and provide for its being carried out by "the person entitled to the first estate of freehold in the property" or otherwise.

Sec. 7. The completion of scheme and place where it may be seen shall be advertised in a local paper "during three consecutive weeks in September, October, or November," and in the following month notice served on every owner, lessee, and occupier of property to be taken compulsorily.

Sec. 8. The L.A. shall then forward a copy of scheme, names of all objectors, and other evidence with petition for order to the L.G.B., or if in County or City of London to the Home Secretary.

If the C.A. think fit to proceed with the case they will direct a local enquiry to be made, and may make a Prov.O. which the L.A. shall serve on all owners, lessees, and occupiers (except tenants for less than a month) affected by compulsory purchase. The C.A. will obtain confirmation of the order by Parliament, and recover expenses from L.A. Costs incurred in justifiable opposition *may* be awarded by Parliament.

Sec. 10. If L.A. fail or refuse to make a scheme they *shall* send copy of O.R., with their reasons for not acting thereon, to C.A., who may direct a local enquiry to be held.

Sec. 11. In London every I.S. shall provide, "within or in the vicinity of the area," "accommodation for at least as many of the working classes" as are displaced thereby. Unless (*a*) the L.A. satisfy the C.A. that such accommodation is or will forthwith be provided elsewhere equally convenient, or (*b*) the C.A. itself see fit to dispense with the obligation to an extent not exceeding half the population displaced: elsewhere than in London this obligation exists only when imposed by the C.A.

Sec. 12. On the confirmation of the scheme the L.A. shall forthwith proceed to carry it out, and *may* for this purpose acquire the land, but (3) shall not themselves do more than demolish existing buildings, and make such new streets as they may think fit, without the express approval of the C.A., in which case (5) they shall (unless the C.A. determine otherwise) sell within ten years all buildings they may have erected. They may, (6) without acquiring the land, contract with the owners or (3) with any other persons for the execution of the scheme, or (2) they may sell or let the whole or any part of the land on condition that the purchasers or lessees carry it out to their satisfaction, with right of re-entry for default or violation of the provisions of the grant or lease, (4) among which shall be the regulation of the size, elevation, and design of the houses, the accommodation afforded, and proper sanitary arrangements.

Sec. 13. If within five years after clearing area set aside for working men's dwellings the L.A. have failed thus to provide for carrying out this part of the scheme, the C.A. may order such land to be sold by auction, fixing a reserve price, and imposing the necessary conditions on the purchasers.

Sec. 14. Thirteen weeks before taking any fifteen or more houses, the L.A. shall give notice by placards affixed on or near the said houses, and shall not take possession until they shall have obtained a certificate from a J.P. that they have done so.

Sec. 15. Should the L.A. desire to make any changes in the original scheme, involving a larger public expenditure or further compulsory purchase, a fresh Prov.O. must be obtained for confirmation by Parliament; otherwise the C.A. may sanction such changes as do not prejudice the proposed accommodation for the working classes, a statement of these changes being submitted to Parliament as early as practicable.

Inquiries respecting Unhealthy Areas.

Sec. 16. Where twelve or more local ratepayers having complained of any area to the M.O.H., he have refused to inspect it or have declared it not to be an *U.A.*, they may appeal to the C.A., who, on their giving security for the costs, may appoint a medical man to inspect it. They shall transmit his representation to the L.A., who must proceed thereon as under sec. 4. The C.A. shall make such order as to costs as they think just, requiring the whole or a part to be paid by the L.A. or by the appellants according as their M.O. declare it an *U.A.* or not.

Sec. 17. The C.A. shall for the purposes of local inquiry (sec. 10) send an officer to inquire into the correctness of the O.R., the sufficiency of the I.S., local objections thereto, &c.

Sec. 18. He shall give sufficient public notice thereof, with the place and time for receiving evidence, have power to administer oaths, and (sec. 19) shall report the results to the C.A.

Acquisition of Land, &c.

Sec. 20 refers to Land Clauses Acts.

Sec. 21. Compensation for lands and interests compulsorily purchased shall be based (*a*) on the fair market value according to last valuation, and of interests therein, regard being had to the nature and actual condition of the property, probable duration, and state of repair. No additional compensation shall be given in consideration of the fact of compulsion; nor (*b*) of any addition or improvement (not necessary for maintenance) made since announcement of scheme, or of interests subsequently acquired.

(2) Evidence may be received by the arbitrator that—	And if satisfied of its truth he shall assess the compensation on—
(α) The rental was enhanced by the premises being let for illegal purposes, or	(α) The rental obtainable if the houses had been let for legal purposes only, or
(β) By their being so overcrowded as to be dangerous or injurious to the health of the inmates.	(β) If accommodating only so many persons as under the circumstances would not involve danger to health.
(γ) They are in such a condition as to be a "nuisance" or in a state of defective sanitation, or not in reasonably good repair.	(γ) Their value after deducting the probable cost of abating the "nuisance" or putting them into a sanitary condition and reasonably good repair.
(δ) They are unfit, and not reasonably capable of being made fit for human habitation.	(δ) The value of the land and of the materials only of the buildings thereon.

Sec. 22. Upon the purchase of the land by the L.A. all rights and easements therein shall cease, and the land be vested in the L.A., subject only to compensation by the L.A., to any persons proved to have sustained injury thereby.

Sec. 23. The L.A. may appropriate any land belonging to them, or purchase by agreement any other suitable land for the accommodation of the working-classes.

Secs. 24 & 25. L.A. may form an improvement fund out of the rates, or by borrowing money on the security of the rates.

General provisions.

Sec. 26. In the illness or unavoidable absence of the M.O.H., the L.A. may appoint (with the approval of the C.A.) a substitute for a period not exceeding six months.

Sec. 27. The C.A. may prescribe forms of advertisements or notices, the use of which shall be optional, but which if adopted shall be deemed sufficient for all purposes of this act.

Sec. 28. On the petition of a L.A. for confirmation of a scheme, the C.A. may sanction other forms of notice, or if reasonable cause be shown dispense with public notice, provided no persons suffer injury in consequence.

PART II. UNHEALTHY DWELLING-HOUSES.

Sec. 29. Definitions. "*Street*" includes any square, court, alley, or row of houses. "*Dwelling-house*" means any inhabited building, and includes the site, with yards, gardens, or outhouses belonging thereto. "*Owner*" includes (besides the definition in the Lands Clauses Acts) all lessees and mortgagees for terms of which not less than twenty years remain unexpired. "*Closing Order*" is one prohibiting the use of premises for human habitation made under Sched. III.

Buildings Unfit for Human Habitation.

Sec. 30. It shall be the duty of the M.O.H. to represent to the L.A. any dwelling-house so dangerous or injurious to health as to be unfit for human habitation, and—

Sec. 31. (1) If any *four* or more *householders*, living in or *near any street, complain* to the M.O.H. that any house therein is unfit for habitation, he shall forthwith inspect the same, and transmit to the L.A. their complaint, with his opinion. (2) If the L.A. (not being in the County of London, or a R.S.A.) decline or neglect to put in force this part of the Act within three months from the receipt of such complaint, with the opinion or representation of the M.O.H., the complainants may petition the L.G.B. for a local inquiry, and the L.G.B. may after such inquiry order the L.A. to take proceedings. (For Metropolitan and R.S.A. see sec. 45 and 46.)

Closing Order and Demolition.

Sec. 32. It shall be the *duty of every* L.A. *to cause to be made from time to time inspections of their district*, and if any house be found *U.H.H.*, to forthwith proceed against the O. or *O.* for its closure [Sched. III.], (2) whether it be occupied or not, and the Court may impose a penalty $<$ £20, and make a C.O. in the forms in Sched. IV., or to the like effect. (3) A C.O. having been made, the L.A. shall serve on every occupier or tenant a notice to quit within a period of not less than seven days, who in default shall be liable to a D.P. $<$ £1. The L.A. may make him such reasonable allowance for his expenses in removing as the Court may order, which shall be recoverable by the L.A. from the owner.

Sec. 33. (1) A C.O. having been obtained and not determined by any subsequent order, the L.A. being of opinion that the house has not been, or is not with due diligence being made fit for habitation, and that its continuance is dangerous to health, shall pass a resolution that its demolition is expedient ; and (2) serve a notice on the owner, appointing a place and time, not less than one month after service, for his attendance to state his objections. (3) After which, unless he undertake forthwith to render it fit ; or (4) if he neglect so to do within a time specified in the order, the L.A. shall order its demolition.

Sec. 34. (1) Such order having been made, the owner shall take down the building within three months, otherwise the L.A. shall do so, selling the materials, and after deducting the cost of demolition, paying the balance (if any) to the owner. (2) No insanitary buildings shall be erected on such site, and if they be, the L.A. may order their abatement, or in the event of non-compliance do it themselves at the owner's expense.

Sec. 35. An owner aggrieved by order of L.A. may appeal to C.Q.S., and meanwhile proceedings shall be suspended. Appeals shall be conducted according to sec. 31 of the S.J.A., 1879, as if the L.A. were such court ; (2) but (*a*) notice of appeal may be given within one month of service of order ; and (*b*) at request of either party the C.Q.S. shall state the facts for the determination of a Superior Court.

Secs. 36 and 37 regulate grant and incidence of charges by way of annuity to owner at rate of £6 for every £100 expended by him in improvements satisfactory to the surveyor of the L.A., to be paid to him or his heirs for a term of thirty years.

Obstructive Dwellings.

Sec. 38. (1) If the M.O.H. find any building, though not itself *U.H.H.* or dangerous to health, (*a*) rendering others so by stopping access of air or light or otherwise ; or (*b*) preventing the removal of such defects therein, he shall report the same to the L.A. as an "obstructive" building which in his opinion should be pulled down ; and (2) any four or more inhabitant householders in the district may do the same. (3) On receiving such representation the L.A. shall cause a report to be made on the circumstances of the building, and the cost of demolition and of the acquisition of the land ; shall consider the report, and if satisfied shall forward to the owner copies of the report and resolution appointing a place and time for hearing his objections ; after which they shall make an order either allowing his objections, or for demolition, subject to appeal as under sec. 35. (4) If such appeal be not entered, or be abandoned or dismissed, the L.A. shall be authorized to purchase it as if by special act under the provisions of the L.C.A. within one year of the order, or of its confirmation after appeal. (5) Within one month of service of notice of purchase the owner may declare his wish to retain the land, undertaking to demolish the building, or to permit its demolition by the L.A., (6) in the latter case receiving compensation, to be settled by arbitration as provided in this Act. (7) When a part only of the building is obstructive, and it can be pulled down without serious detriment to the rest, the owner shall not insist on purchase of the entire site, but shall receive compensation for detriment, as well as for the value of the part taken. (8) If the arbitrator deem that the removal of the obstructive building enhances the value of other property he shall apportion the charge for compensation among the owners of the latter as P.I.E. under the P.H.A. (9) Disputes between these owners and the arbitrator shall be decided by two J.P.s. (10) An owner retaining the site shall not erect thereon any obstructive, dangerous, or insanitary buildings (11, 12). When the L.A. purchase the site, they shall keep open the whole, or so much as may be necessary for the purpose, or may dedicate it as a highway.

Scheme for Reconstruction.

Sec. 39. (1) [*a*] If an order for demolition having been obtained, the L.A. deeming it advantageous to the public health that the area should be dedicated as a highway or open space, or appropriated, sold or let for erection of dwellings for the working classes, or exchanged for other land more suited for this purpose, but (*b*) that the area is too small to be dealt with as an *U.A.* under Pt. I., they shall pass a resolution to that effect, and prepare an I.S.

(2) Same as Sec. 7.

(3) Same as Sec. 8.

(4) An order having been obtained, no confirmation is needed if all the land be taken by agreement, and it takes immediate effect; otherwise the L.A. must publish it in *London Gazette*, and serve the notice on every owner.

(5) Owners may within two months after such publication appeal to L.G.B., and if appeal be not withdrawn it is a Prov. O. only, till confirmed by Parliament.

(6) Otherwise, after two months the L.G.B. shall confirm the order, which shall then come into immediate operation.

(7) The order may incorporate provisions of L.C.A.; the area shall be acquired by L.A. within three years of confirmation, and compensation be settled by arbitration as herein provided.

(8) Same as Sec. 22.

(9) Same as Sec. 15.

Sec. 40. Substantially same as Sec. 11.

Sec. 41. Compensation to be settled by an arbitrator or arbitrators appointed and removable by L.G.B., whose awards shall be final and binding on all parties (2, 3). The bases of valuation as in Sec. 21. The remainder of this section is incorporated from L.C.A. 8 & 9 Vic. cap. 18.

Secs. 42 and 43 relate to borrowing powers and levying of rates for purposes of the Acts.

Sec. 44. Every L.A. shall every year present to L.G.B. an account of all proceedings, expenses, and receipts under this Act in the forms prescribed.

Powers of County Councils.

Sec. 45. In the County of London, including Woolwich, and in all R.S.D., the powers of the L.G.B. defined in Sec. 31 are delegated to the L.C.C. or other C.C.

(4) The officers of the C.C. have the same rights of admission to premises for the purposes of the Act, enforceable if necessary by order of J.P., as are enjoyed by those of the district authority.

Special Provisions as to London.

Sec. 46. (1) Provisions of P.H.A. (Pt. VI. sec. 213—215), as to P.I. rates for the purposes of this Act, extend to the County of London; and all L.A.s, and the C. of S. are to be deemed U.S.A.s. (2) The L.C.C., L.A.s and C. of S. may borrow for these purposes as under M.M.A., and (3) the L.C.C. may lend money to any L.A. in London. (4) In applying sec. 38, sub. 11, and sec. 44 of this Act to London substitute a S.S., *i. e.* Home Sec., for L.G.B. (5) When the L.C.C. proceeds with an I.S., whether acting as a L.A. or on representation of one, all the provisions of this Act shall apply to the L.C.C. as if it were a L.A., and the expenses be borne by the County fund, save when (6) the L.C.C., thinking that the L.A. ought to pay the whole or a part thereof, and on application being made by the L.C.C. to the S.S., he decides accordingly, and the payment becomes a contract debt of L.A. to L.C.C. (7) Conversely, the L.C.C. may contribute voluntarily to the cost of a scheme carried out by L.A., or L.A. may apply to S.S. to compel L.C.C. so to do. (8) The L.B.H. of Woolwich shall be deemed an U.S.A. under this Act, but all moneys shall be raised as provided by the P.H.A.

Supplemental.

Sec. 47. (1) When the superior landlord or owner on whom notice has been served is not the person in receipt of the rent and profits, he may inform the L.A. thereof, when notice shall be served on the other. (2) And if he satisfy a C.S.J. that he is being prejudiced by the delay or default of such person to carry out the works or demolition ordered by L.A., or claim to retain the site, the Court may make an order enabling the applicant to re-enter and to perform the work specified within the time named, or (3) within such further extension of time as the Court think fit, (4) giving notice of such order to the L.A.

Sec. 48. Rights or remedies of such owner for breach of covenants on part of any lessee or tenant shall not be prejudiced by such order or by his taking possession subsequently to such breach or non-performance.

Sec. 49. (1) When the owner and his address are known, the clerk of the L.A. shall cause notices to be served on him or some inmate of his house, or place of business, if within the district, or if without it shall transmit them by post in a registered letter. (2) When the owner cannot be found, the notice shall be addressed to "the owner," and served on the occupier, or if there be none, affixed to "some conspicuous part of the building." (3) Notices served on his agent shall be deemed to have been served on the owner.

Sec. 50. "The owner" shall be a sufficient description.

Sec. 51. (1) If after due notice has been given the occupier or owner obstruct the M.O.H., servants or workmen of the L.A., or the occupier thus obstruct the owner in carrying out an order of the L.A., a C.S.J. may order such obstruction to cease; and (2) if he fail to comply within ten days, he shall be liable on summary conviction to a penalty not exceeding £20, provided that the owner, if he do not assent to the obstruction by the occupier, shall not be liable.

Sec. 52. A representation from the M.O.H. of a county forwarded by the C.C. to the L.A. of any district in the county, not being a borough as defined by the Municipal Corporations Act of 1882, shall have the like effect as a representation by the M.O.H. of the L.A.

Part III. Working-Class Lodging-Houses.

Adoption of Part III.

Sec. 53. (1) "Lodging-House" includes separate houses for the working classes, whether containing one or several tenements, and "cottages" include gardens belonging thereto, not exceeding half an acre in area, or £3 in annual value.

Secs. 54 and 55 repealed by H.W.C.(A.)A. 1900.

Secs. 56, 57, 58. Subject to provisions of sec. 55, as to R.S.A., the L.A. may exercise all powers of contract, &c., as under M.M.A., &c., and (1) purchase land as under P.H.A., sec. 175—178 (substituting S.S. for L.G.B., when the L.A. is the

L.C.C. or Comm. of Sewers); or (2) contract for purchase of Lodging-Houses now or to be built; or (3) with the consent of the L.G.B. (or if a R.S.A. with that of the C.C.), appropriate for the purposes of this part of the Act any houses bought or leased by them, or any lands at their disposal; or purchase or lease lodging-houses previously vested in trustees.

Sec. 59. L.A. may erect lodging-houses on any land held or acquired by them for the purpose, or may convert existing buildings, and improve and furnish the same.

Sec. 60. L.A. may with the consent of L.G.B., or if a R.S.A. of the C.C., sell land held by them and purchase other better adapted for the purpose, or exchange without sale and purchase.

Sec. 61. L.A. shall have the control and management of such lodging-houses, and make charges for occupation.

Sec. 62. They may make B.L.s for regulation of the same and shall have a copy or abstract kept in every room.

Sec. 63. Receipt by husband or wife of parochial relief, other than temporary relief in sickness, shall disqualify for further occupation.

Sec. 64. If after seven years the L.A. consider such lodging houses unnecessary, or too expensive, they may with consent of L.G.B., or if a R.S.A. of the C.C., sell and dispose of the same.

Expenses and Borrowing of L.A.

Sec. 65. All expenses incurred by L.A. in executing this part of the Act shall be defrayed, (1) in the County of London out of the Dwelling House Improvement Fund under Part I. sec. 24 of this Act; (2) in other U.S.D. as part of *general* expenses under P.H.A. sec. 207; and (3) in R.S.D. as *special* expenses under sec. 229. The C.C. may in their certificate, if desired by the R.S.A., declare these general expenses to be borne by the whole district, or if by a contributory place only to be raised as if such place were an entire district under P.H.A. sec. 230.

Sec. 66. Borrowing for the purposes of this part of the Act by any L.A. whatever to be under the conditions and in like manner as laid down for U.S.A. in Part I., sec. 25.

Loans to Companies, Societies, and Individuals.

Sec. 67. The P.W.L.C. may make loans to any companies, societies, or persons possessed of estates in fee simple or for a term of years absolute of which fifty remain unexpired, for the construction or improvement or for facilitating the same of dwellings for the working classes in general or in their employment. (2) Whether such persons or person be or be not otherwise entitled to borrow or mortgage, subject, however, to any regulation restricting a company from borrowing until a definite portion of capital is subscribed, taken or paid up. The period for repayment shall not exceed forty years, and no mortgage be effected on land or dwellings unless held in fee simple or for fifty years unexpired; nor shall the sum advanced exceed one-half of the value of the property whether in the first instance or in instalments, as the construction of the dwellings proceeds. (3) Every such body shall, if not so already, be deemed a body corporate, with perpetual succession.

Sec. 68. Railway, dock, trading and manufacturing companies employing labourers are hereby authorized (notwithstanding any Act of Parliament, charter, rule, or order to the contrary) to erect on their own or any other land dwellings for any or all of the working people in their employment.

Sec. 69. Gas and water corporations, &c., or persons having control of water supplies, may at their discretion provide water or gas to lodging-houses under this part of the Act gratuitously or on favourable terms.

Sec. 70. All such lodging-houses shall at all times be open to inspection by the L.A. and its officers.

Sec. 71. Fines imposed for breach of bye-laws shall be paid to credit of funds out of which the expenses of this part of the Act are defrayed.

PART IV. SUPPLEMENTAL.

Sec. 72. When an O.R. made to the L.C.C. refers to not more than ten houses, the L.C.C. shall direct the M.O.H. to represent the case to the L.A. under Part II., to be dealt with by them according thereto.

Sec. 73. If the M.O.H. have represented a case to the L.A. under Part II., or to the L.C.C. under Part I., and the L.A. or L.C.C. respectively are of opinion that it ought to be dealt with under the other parts, the L.A. or L.C.C. as the case may be may submit their resolutions to a S.S., who may appoint an arbitrator to hold a local inquiry and report to him under which part he considers that proceedings should be taken, and if under Part II., whether the L.C.C. should contribute to the expenses, and the S.S. may then give his decision and direct the M.O.H. to make the representation accordingly.

Sec. 74. Amends the Settled Lands Act, 1882, by permitting the sale, lease, or exchange of such lands for the purpose of erecting dwellings for the working classes, provided such be not injurious to the estate, on the best reasonable terms, notwithstanding that a better price or rent could have been obtained had the land been sold or let for other purposes.

Sec. 75. In any contract made after Aug. 14, 1885, for letting a house or part of a house for habitation by persons of the working classes, it shall be an implied condition that such house is then "in all respects reasonably fit for human habitation." "Letting for habitation by persons of the working classes" means at a rent not exceeding the limit for composition of rates, in London £20, in England and Wales £8, and in Scotland and Ireland £4. [This section can be evaded by "contracting out."—E. F. W.]

Sec. 76. The L.C.C. may with consent of S.S. appoint one or more medical men with such remuneration as they think fit for carrying into effect any part of this Act, and such medical men as well as their M.O.H. shall be deemed to be and have the powers of a M.O.H. to the L.A. in question.

Sec. 77. Any person authorized by the L.A. may, on giving twenty-four hours' notice in writing to the occupier, enter at all reasonable times of the day any house or premises for the compulsory purchase of which the L.A. has obtained powers, for the purpose of surveying and valuing the same.

Sec. 78. When any building purchased by the L.A. in pursuance of a scheme under Parts I. or II. is not closed, and is occupied under a tenancy of less than one year, the L.A. if they require the tenant to give up possession may award him reasonable compensation on account of his expenses in removing.

Sec. 79. Every representation made by a M.O.H. shall be in writing, and a person acting temporarily as M.O.H. shall have like powers under Parts I. and II. as a permanent M.O.H.

Sec. 80. Separate accounts of receipts and expenditure under each part of this Act shall be kept by the L.A., and audited as other accounts required to be audited by law.

Sec. 81. A L.A. may appoint a committee from their own number for carrying out all proceedings under this Act, except borrowing moneys, levying rates, and making contracts.

Sec. 82. The application of the proceeds of sales shall be approved by L.G.B.

Sec. 83. The interest on loans by the P.W.L.C. shall bear interest not exceeding 3⅛ p.c.

Sec. 84. Sections 200 and 203 of the M.M.A. shall apply to all bye-laws within the administrative county of London, and the provisions of the P.H.A. to those of all other S.A.s.

Sec. 85. The costs of all local inquiries instituted by the L.G.B. or other C.A., including remuneration of officers not exceeding £3 3*s.* per diem, shall be paid by the L.A. and persons concerned, or by such of them and in such proportions as the L.G.B. or C.A. shall decide, and shall be a debt payable by them to the Crown. Secs. 293 to 296 and 298 of the P.H.A. shall apply to all inquiries and orders of L.G.B.

Sec. 86. An order of the L.A. shall be under their seal and be signed by their clerk or his deputy, and all notices, demands, &c. be so signed.

Sec. 87. All legal notices, summonses, &c., served on the L.A. in respect of proceedings under this Act shall be served on their clerk or left at his office with some person employed there.

Sec. 88. No member of a L.A. or C.C. may vote in respect of proceedings under Part I. or II., if he be beneficially interested in the property concerned under a penalty of £50, but the fact of his having done so shall not invalidate any resolution.

Sec. 89. Penalty for obstructing M.O.H. or any officer of L.A., or C.A. of Pt. I., a fine $<$ £20 on summary conviction.

Sec. 90. Prosecutions to be conducted and penalties imposed as under provisions of S.J. Acts.

Sec. 91. All powers conferred and duties imposed on L.A.s by this Act shall be in addition to and irrespective of those already possessed by or incumbent on them.

Sec. 92. Unless the context otherwise require, the terms district, L.A., and local rate shall have the meanings indicated in Sched. I., but in Part III. only where that part is adopted.

Sec. 93. "Land" includes rights over land. S.D. and S.A. include U. and R.S.D.s and A.s, and these terms, with "contributory place," have meanings assigned in P.H.A. 1875. "Superior Court" means Supreme Court. "County of London" does not include the City, except where specified as the "Administrative County."

PART V. APPLICATION TO SCOTLAND.

Sec. 94. Substitute for the Land Clauses Consolidation Act 1845, that of the same title and year for Scotland, and where disputes are to be settled by two J.P.s, the amount of compensation being under £50, they shall be settled by the Sheriff as provided in the Scotch Act.

For P.H.A. 1875, read P.H. (Scotland) Act 1897, and any amending the same. For sec. 175—178 P.H.A., read sec. 145 P.H.(S.)A. 1897.

Local inquiries held by S.S. for Scotland under L.G.(S.)A. 1889, and those by Board of Supervision under P.H.(S.)A. 1897, sec. 7—10, but sec. 85, subs. 1 of this Act shall apply to the latter.

Provisions for defraying expenses of private improvements do not apply to Scotland, but the L.A. may recover summarily the portion of compensation for demolition of obstructive buildings imposed by sec. 38, subs. 8, on the owners of property the value of which is thereby enhanced.

Acts relating to nuisances mean in Scotland, the P.H.(S.)A., 1897, and any Acts amending the same; also such sections of L.G.(S.)A., 1889, and any Local Acts relating to nuisances.

Sec. 95. A charging order under Pt. II. shall be recorded in the register of sasines. Superior Court means Court of Session. Appeal from order of L.A. under Pt. II. shall be made to the Sheriff with same procedure as in appeals to him from the sheriff substitute, but with the provisoes of this Act for appeals from order of L.A. to C.Q.S. "Summary proceedings" may be taken before the Sheriff or two Justices, or in burghs two magistrates, on whom all necessary powers are hereby conferred.

Sec. 96. For L.G.B., read Secretary of State for Scotland, and in Part III. for the C.C. substitute the Board of Supervision. Expenses of L.A. may be defrayed as general expenses under P.H.(S.)A., secs. 133—145, provided that the assessment therefor be levied only in the parishes in which the expenses were incurred.

For London Gazette, read Edinburgh Gazette.
For M.O.H., read M.O.
For C.Q.S., read Sheriff.

By U.S.A. understand a local authority under P.H.(S.)A., being a town council, or police commissioners, or trustees having like powers.

By R.S.A. understand a District Committee, or where county is not divided into districts, the C.C.

For "contributory place" read parish. "C.S.J." means a Sheriff, or any two J.P.s sitting in open court, or any magistrates within meaning of S.J.A. "Exōrs, admōrs, or assigns," mean heirs, executors, or assignees. "Mortgage" means any bond or disposition in security. Quit-rents, charges incident to tenure, and tithe-commutation rent-charges, shall be read as feu duties, casualties, and teinds. The provisions of the P.H.(S.)A. 1897 shall apply with necessary variations to all bye-laws authorized to be made under this Act, and penalties under such bye-laws be recoverable on summary conviction.

When the L.A. have not a seal, any order in writing shall be authenticated by signature of two or more members, in addition to that of the clerk.

Provisions of Part II. as to powers of C.C. shall not apply to Scotland.

Sec. 97. The superior of any lands or heritages may give notice of his right of superiority to L.A., whereupon L.A. shall give him notice of any proceedings under Part II. relating thereto. (2) If on application of the Superior, it appear to the Sheriff that default is being made in respect of works ordered under a C.O., or in demolitions or in claim to retain site under Part II., and that applicant is prejudiced by such default, the Sheriff may empower him to re-enter and to perform the same within the time fixed, and (3) may extend such time, but (4) shall communicate any such order to the L.A.

PART VI. APPLICATION TO IRELAND.

Sec. 98. For P.H.A. 1875, read P.H.(I.)A. 1878, so far as it contains like provisions, and in particular secs. 175, 176, 177, P.H.A., = secs. 202, 203, 204, P.H.(I.)A.; secs. 293 to 296, and 298, P.H.A. = secs. 209, 210, 212, 213 and 215 of P.H.(I.)A.

Acts relating to nuisances mean P.H.(I.)A., and any such provisions in local acts. Q.S. mean in towns where there are no separate Q.S., the Q.S. of the division of the county in which they are situate. Appeals from order of L.A. to C.Q.S. under Part II. shall be conducted according to sec. 24 of Petty Sessions (Ireland) Act, and any Amending Acts, as if the order were one of a C.S.J., but subject to the provisions in this Act.

For L.G.B., read L.G.B. (Ireland). For P.W.L.C., read P.W.C. in Ireland acting with the consent of the Treasury. M.O.H. to include Superintendent M.O.H. For *London Gazette* read *Dublin Gazette.* Charging orders shall be registered in office for registering deeds, conveyances, and wills. Where L.A. have no seal, the signatures of two or more members must be appended to every written order, in addition to that of the clerk. Accounts of L.A. under this Act audited as other accounts required to be so by law. Consent of Treasury shall be substituted for that of L.G.B. required in Part III. secs. 57 & 64.

Sec. 99. (1) In the adoption of Part III. by small towns not being U.S.D., any commissioners existing for paving, lighting, &c., under any Act or Charter shall be deemed to be the L.A. (2) They shall give not less than twenty-eight nor more than forty-two days' notice of their intention to consider its adoption, and of time and place of meeting for its consideration.

(3) If not less than one-tenth in value of the persons liable to be rated for the purpose present there a written request for postponement for one year, it shall be so postponed, and resumed so soon after that time as the L.A. may think fit.

(4) If adopted, the rate shall be the local rate for paving, &c., but such rate may, with the approval of the Treasury, be increased for the purpose.

(5) The *net* income arising from such lodging-houses, &c., including interest and instalments of principal of loans, shall be paid in aid of the rate applied for the purposes of this part of the Act.

Sec. 100. Sec. 56—64, 99—103, of the Commissioners' Clauses Act, 1847, shall be incorporated with Pt. III. so far as town, dock, or harbour commissioners or companies are concerned, and the expression "special Act" shall mean this Act.

Sec. 101. (1) Companies, &c., establishing lodging-houses under this Act shall have like power with L.A. of making bye-laws therefor which (2) must be approved by L.G.B. with their seal and the signature of Secretary of L.L., P. or V.P., or two members of L.G.B., (3) when any fines imposed thereby shall be recoverable before a C.S.J., and equally divided between the informer and the authority making them, which shall apply their share in aid of the expenses of the lodging-houses.

By 59, 60, Vic. c. 11 for the purposes of this Act the Town Commissioners of any town not an U.S.A. adopting Pt. III., shall have all the powers of a S.A., and if not a body corporate shall be deemed such with perpetual succession.

Part VII. Repeal and Temporary Provisions.

Sec. 102. All previous Acts on like subjects are hereby repealed, except secs. 3, 7, 8, 9 and 10, so far as it relates to bye-laws of the H.W.C.A. 1885. Sec. 6, P.W.L.A. 1879, is also repealed [see Sch. VII.]. Provided that (1) the adoption of the Labouring Classes Lodgings Acts, 1851 to 1885, shall be deemed an adoption of Part III. of this Act, which shall henceforth apply accordingly. (2) Any officer appointed under former Acts shall continue and be deemed to be appointed under this Act. (3) Any houses acquired by and already vested in L.A. under Artizan's Dwellings Acts, 1868—1885, shall be held to be so under Part III. of this; and any land or premises other than dwelling-houses, as if acquired under Part II. sec. 38 (obstructive buildings), but may be appropriated to the purposes of Part III. with the consent of C.A.

Sec. 103. Provisions as to compensation shall be applicable to all improvement schemes confirmed by Parliament during the session (53 and 54 Vic.) in which this Act was passed.

(*Customs and Inland Revenue Act*, 1890, *sec.* 26, *subs.* 2.)

Houses built or adapted for tenements at, and occupied solely by tenants paying rents < 7*s.* 6*d.* a week, shall be exempt from Inhab. Ho. Duty, provided the M.O.H., having inspected the premises at request of person liable to pay duty, certify to their suitable accommodation for each family and proper sanitary condition. [M.O.H. cannot charge fee or claim remuneration, but L.G.B. will consider proposals from L.A.] L.A. may appoint *ad hoc* any other M.O. having qualifications for M.O.H. *in loco*.

HOUSING OF THE WORKING CLASSES ACT, 1900.

(*Amending* Pt. III. of H.W.C.A., 1890.)

Sec. 1. Any council, not a R.D.C., may, having adopted Pt. III., establish or acquire out of their district L.H.s for W.C.s.

Sec. 2. (1) A R.D.C. may, with the consent of the C.C. adopt Pt. III. for their whole district, or any part thereof, which shall be a C.P. (2) The C.C. on receiving application from R.D.C shall make a L.I., in which they shall have regard to (*a*) the character of the area in question, (*b*) the need for such accommodation, (*c*) the probability of its being otherwise provided, and (*d*) the ability of the district or C.P. to bear the expense. (3) The principal Act is hereby repealed as to §§ 54 and 55, and § 65 from "and save where" to "bear such expenses," and "at the time of the publication of the certificate," and "who publish the same." [The necessary corrections have been made in the abstract of the principal Act.—E. F. W.]

Sec. 3. (1) Expenses incurred by Councils of Metropolitan Boroughs under Pt. III., within or without the Borough, shall be defrayed as ordinary expenses, (2) and the power of borrowing exercisable as under Pt. II.

Sec. 4. When land acquired under Pt. III. is used for rehousing persons displaced by the Council under other parts of the Act, the expenses and receipts connected with such lands or buildings erected thereon may be treated as expenses, &c., under the Act, but must be entered under a separate head.

Sec. 5. (1) L.A., if not R.D.C., may, with consent of L.G.B., and if R.D.C., with that of C.C., lease land acquired under Pt. III. to any persons who will carry out the scheme, the L.A. by provisions and conditions of leases, approval of plans, control of alterations and other precautions, with right of re-entry for breach of the same, securing its proper execution. (2) Secs. 61 and 62 of principal Act not to apply.

Sec. 6. If a Parish Council resolve that the R.D.C. ought to have adopted Pt. III., or exercised its powers under the same, the C.C., if after L.I. satisfied as to the default, may assume powers of R.D.C. for tho purposes of the Act (Sec. 63 L.G.A., 1894).

Sec. 7. Arbitration in acquisition of land.

This Act not to extend to Scotland or Ireland.

LOCAL GOVERNMENT ACT, 1894.

Sanitary Powers of Parish Councils.

Sec. 8 (1) enables parish councils, provided no private rights or those of other L.A.s be thereby infringed, (*e*) to utilize for water supplies any well, spring, or stream within their districts, (*f*) to deal with any pond, ditch, drain or place receiving filth, drainage, &c., likely to be prejudicial to health, (*i*) to execute any works for these purposes on land other than ecclesiastical property, and (*k*) to combine with or contribute towards the expenses of any other parish council in carrying out such works. But (3) nothing in this section shall derogate from the obligations of a District Council in respect of Water Supply or Sanitary Works.

Sec. 15. Authorizes a R.D.C. to delegate to a Parish Council any of their powers under the P.H.A. to be exercised by the Parish Council within their district, but only as agents of the R.D.C. (P.H.A., sec. 202), who shall not be relieved thereby of their obligations in respect of the same.

Sec. 16. Empowers a parish council to complain to the C.C. of default by the R.D.C. in respect of water supply or sewerage.

Sec. 63. Authorizes the C.C. in such cases to assume the powers of the R.D.C. and to recover the cost of executing the necessary works.

[These powers are in addition and without prejudice to the right of any persons sole or corporate to appeal under such circumstances to the L.G.B. conferred by the P.H.A., sec. 299.]

PUBLIC HEALTH (WATER) ACT, 1878.

Sec. 3. "It shall be the duty of every R.S.A. to see that every occupied dwelling-house within their district has within a reasonable distance an available supply of wholesome water sufficient for the consumption and use for domestic purposes of the inmates of the house." If the supply be insufficient, and owner neglect to make provision, the L.A. *may* after two notices, and after at least seven months from date of first, provide it, charging the owners and recovering the cost summarily or as P.I.E. Owner may appeal to L.G.B. after second notice.

Sec. 6. No house may be built or rebuilt in a R.D. without a proper supply of wholesome water, under a penalty < £10. A certificate must be obtained from the M.O.H. or I.N.,[1] and if refused owner may appeal to L.G.B.

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[1] This is no part of the duties of, and demands knowledge not possessed by, Inspectors. It is also without any precedent in other Acts.

Sec. 7. R.S.A. shall from time to time inquire into the condition of the water supplies within their district, and may spend money for analyses and otherwise for the purpose. They shall also have right of entry under §§ 102 and 103 P.H.A., if they have "reasonable ground" for supposing a supply to be insufficient.

DISTRICT COUNCILS (WATER SUPPLY FACILITIES) ACT, 1897 (60 & 61 Vic. c. 14).

Enables landowners, limited or other, to arrange, subject to the approval of the Board of Agriculture, with R.D.C.s (in place of Land Improvement or Loan Companies as under previous Acts of 1877, &c.) for the provision of supplies of pure water in their districts; and to advance money, or charge their estates for extensions of water-mains and the like. It must be read with the Improvement of Lands Act, 1864, and does not extend to Scotland and Ireland.

METROPOLIS WATER ACT, 1897 (60 & 61 Vic. c. 56).

(*This Act is additional to, and does not supersede any rights or remedies established by existing Acts.*)

Jurisdiction in matters of law and of fact, and *locus standi* of complainants, with power to award damages and costs, and impose penalties, enforcing the same as rules or orders of the High Court as directed by 17, 18 Vic. c. 31, § 3; 36, 37 Vic. c. 48, § 26; and 51, 52 Vic. c. 25, § 8, is conferred on the Railway and Canal Commission (R. & C.C.); all enactments relating to them in the R. and C. Traffic Act, 1894, and elsewhere, apply here *mutatis mutandis*.

Appeals on questions of *law only* may be made to the Court of Appeal.

L.A. means L.C.C., Bo.Co., and any D.C. Consumer is any person paying, or liable to pay, any charge under whatever name for water supplied, or owner or occupier of any house entitled to a supply from any Water Company or authority.

Sec. 1. Any L.A. or consumer may complain to R. and C.C. of (1) any default of a M.W.Co., or (2) quantity or quality of water, and (3) the R. and C.C. may order under penalty removal of ground of complaint, within a reasonable specified time, with or without award of costs or damages. R. and C.C. may order or arrange joint action by two or more M.W.Co.s.

Sec. 2. Enables L.A. to aid any consumer in obtaining redress or in any matter of importance to consumers within their district, whether the complainant reside therein or no, and whether complaint be made to R. and C.C. or not. Such L.A. may be made a party to the suit and to bear its part of the costs.

ISOLATION HOSPITALS ACT, 1893 (56 & 57 Vict. c. 68).

This Act, which does not extend to Scotland and Ireland, nor to London or County Boroughs, nor to other boroughs without the consent of their councils, save when in the case of those having fewer than 10,000 inhabitants, the L.G.B. direct that it shall so extend, is intended to enable C.C.s to promote the erection of infectious or isolation hospitals in any part of their districts, save as aforesaid, on application made to them by one or more L.A.s, or by not less than twenty-five ratepayers in any contributory place.

On receipt of petition (sec. 5) the C.C. may (sec. 6) direct an inquiry by their M.O.H., and may themselves initiate action.

Sec. 8. A hospital district shall consist of one or more local areas, and (sec. 10) a committee of management be formed by C.C. having power to acquire by purchase or lease any land within or (sec. 11) without the hospital district. Appeals against such hospitals may be made to L.G.B.

Sec. 13. Provides for ambulances and telegraphic communication, and

Sec. 14. For additional accommodation in emergencies.

Sec. 15. Empowers committee to provide and train nurses for attendance on infectious cases outside the hospital, and to charge for the same, and (sec. 16) provides for defraying of hospital expenses, as well as for charging as "special patients' expenses" the cost of exceptional accommodation when desired. By § 17 all expenses must be classified as "structural," "establishment," and "patients' expenses" and (secs. 13—19) the cost of treatment is recoverable in the case of paupers from the guardians, of non-paupers from the L.A., and of "special patients" from themselves. There are provisions as to borrowing powers, contributions from county expenses of isolation hospitals, &c.

N.B.—The formation of hospital boards was already provided for under P.H.A., § 279, the procedure involving a P.O. from L.G.B. and confirmation by Parliament. The procedure under the special Act is simpler, speedier, and less costly, but the powers of the Committee are less.

VACCINATION ACTS, 1867, 1871, 1898.

[Though the work of providing against the spread, and for the mitigation, of *D.I.D.* has been entrusted to the S.A.s, vaccination is still in the hands of the Guardians; but a few clauses of the Acts may not be out of place.]

Vaccination Act, 1867, sec. 8. L.G.B. may from time to time authorize payment for re-vaccination under specified conditions.

Sec. 9. Guardians may incur reasonable expenses on notices, inquiries, and reports on small-pox and vaccination in their district, and in the prospect or presence of an outbreak on measures for preventing its spread and promoting vaccination.

Vaccination Act, 1871, sec. 9. When free re-vaccination is authorized by L.G.B., a re-vaccinated person failing to present himself for inspection shall pay the fee of 2*s.* 6*d.* to the Guardians.

Sec. 13. A poor law medical officer vaccinating or re-vaccinating under conditions prescribed by L.G.B., persons in a house where he has found a case of small-pox, shall be paid for the operations by the Guardians as if he were a Public Vaccinator.

Vaccination Act, 1898, sec. 1. (1) Children are not required to be vaccinated under age of six months, or to be taken to P.V. (2) P.V. to visit house at request of parent, and (3) if not asked within four months of birth of infant shall, after twenty-four hours' notice, visit for the purpose with L.G.B. lymph, but (4) shall not vaccinate if house be dangerously insanitary, or there have been recently *I.D.*, and shall report to M.O.H.

Sec. 2. Parents obtaining from two J.P.s, or one stipendiary, certificate of "conscientious objection" within four months of birth of child, and sending same to V.O. within seven days, shall be exempt from prosecution under V.A., 1867, secs. 29 & 31.

Sec. 7. L.G.B. may, in prospect or presence of outbreak of small-pox or other emergency, require Guardians to provide vaccination stations, with supply of L.G.B. lymph.

SALE OF FOOD AND DRUGS ACT (1875).

Sec. 2. Definitions. Food includes drinks, but not water or drugs. Drugs are medicines for internal or external use. County includes any division of the same, and counties of cities and towns not being boroughs. Justices include J.P.s, stipendiary and police magistrates.

Sec. 3. No person shall mix, colour, stain, or powder, or cause or permit so to be any article of food, so as to render it injurious to health, with intent that it shall be sold in that state; nor sell such article of food, under a penalty < £50 for a first offence, and on a subsequent conviction of imprisonment with hard labour for a period < six months.

Sec. 4. Save as hereinafter provided, the same prohibitions and penalties apply to the like treatment of drugs "so as to affect injuriously their quality and potency," and their sale—

Sec. 5. Unless the person charged can satisfy the justice or court, that he did not know, and "could not with reasonable diligence have known," that the food or drug was so adulterated.

Sec. 6. (1) No person shall sell any food or drug which is "not of the nature, substance, and quality" demanded under a penalty < £20, except when the addition has been made not to increase its bulk, weight, &c., or to conceal its inferior quality, but is required for its preparation as an article of commerce, in a state fit for carriage or consumption, or (2) it is a proprietary medicine, or the subject of a patent and corresponds with the specification, or (3) is "compounded" as herein mentioned, or (4) when the extraneous material is an unavoidable admixture in the process of collection or preparation.

Sec. 7. No person shall sell a compound article of food or drugs not composed of the ingredients demanded under a penalty < £20—

Sec. 8. Unless, the addition being such as is permitted by § 6, subs. 1, he give the purchaser a legible label stating that the article is so mixed. [Margarine may be sold as such, and labelled, but must not be mixed with butter.]

Sec. 9. No person shall, with intent that it shall be sold in that state, and without notice, abstract from any article of food any part so as to impair its quality, &c., or sell the same without disclosing the alteration, under a penalty < £20.

Sec. 10. The L.A. of counties, cities, metropolitan districts, and boroughs may appoint public analysts, on terms to be mutually agreed on, subject to approval of L.G.B. as respects appointment and removal, but no person directly or indirectly interested in sale of food or drugs shall be eligible.

Sec. 11. The town council of a borough may appoint the analyst of another, or of the county in which it is situate.

Sec. 12. Where a public analyst is thus appointed, any purchaser of an article of food or drug within the district shall be entitled to have it analyzed for a fee of 10*s.* 6*d.*, otherwise by another public analyst, at such fee as he may require, and in either case to have a certificate of the result.

Sec. 13. Any M.O.H., S.I., I. of Weights and Measures, or of markets, or police constable acting under the authorities appointing them, may procure samples of foods or drugs to be submitted to the analyst of the district; or if there be none to some other public analyst on the terms provided in § 12, and receive from him a certificate of the result.

Sec. 14. The purchaser shall immediately notify to the seller his intention of submitting it to the *public* analyst, and offer to divide it into three parts, securely sealing each part as its nature best allows, deliver one to the seller, retain one himself, and forward the third to the analyst.

Sec. 15. If the seller decline the offer, the purchaser shall not divide it, but the analyst shall into two parts, causing one to be delivered to the purchaser, either then or after examination of the other, for production in case of prosecution.

Sec. 16. If the analyst reside beyond two miles, the sample may be sent by post as a registered letter or parcel.

Sec. 17. If any officer, inspector, or constable, asking for a reasonable quantity of any food or drug sold in the shop, tender the price thereof, the seller refusing to serve him shall be liable to a penalty $<$ £10.

Sec. 18. The analyst's certificate shall be in the following form or to the like effect (Schedule).

"To [*name of person submitting the article*].

"I, the undersigned, Public Analyst for the [*County*, *Borough*, *&c. of* . . .], do hereby certify that I received on the . . day of . . . from [*name of person delivering it, or the postal officer*], a sample of [*description of article*] for analysis (which then weighed[1] . . .), and have analyzed the same, and declare the result of my analysis to be as follows—

I am of opinion that the same is a sample of genuine . . . or

I am of opinion that the said sample contained the parts as under . . . or

The percentages of foreign ingredients as under—

Observations.[2]

As witness my hand, this . . day of . . .
A. B.
At

[If the purchaser neglect any of the formalities prescribed in §§ 14, 15, especially the mention of the "*Public* Analyst," the summons will be dismissed.]

Sec. 19. Every public analyst shall send in to his authority a quarterly detailed report of the articles submitted to him under this Act, the results of the analyses, and the sums paid to him, and the authority shall annually transmit certified copies of these reports to the L. G. B. as the Board may direct.

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[1] This may be omitted if inconvenient.

[2] Here the analyst may insert at his discretion his opinion as to the purpose of the mixture, if presumably intentional, or if probably accidental or unavoidable, whether in excess of what is ordinary, and whether the materials are injurious to health or not. He must state the *nature* and *percentage definitely;* such descriptions as "practically all chicory," or "30 per cent. of other vegetable matters," have led to cases being dismissed. In the case of articles liable to decomposition, he shall state whether any change has taken place, and if so, how it would interfere with the analysis.

Sec. 20. If the analyst certify to a violation of the Act, the person causing the analysis to be made may proceed for the summary recovery of the penalty before any P.S.C. in the place where the article was sold.

Sec. 21. The analyst's certificate shall be *primâ facie* evidence for prosecution, but defendant may require the analyst to be called and examined, and may tender himself or his wife to give evidence in his own behalf. The portion of the article retained by prosecutor shall also be produced in court.

Sec. 22. The J. before whom the complaint is made, or the C. before whom an appeal is heard, may at request of either party at their discretion cause one portion of the food or drug to be sent to the Comm. of Inland Rev., to be examined by analysts at Somerset House, whose certificate shall be returned to the J.s, the expenses being paid as they may by order direct by the complainant or the defendant.

[This constitution of the chemists at Somerset House into a Court of Appeal is felt as a grievance by Public Analysts, since neither by their scientific status nor their special experience are they qualified to assume such a character. Their ordinary duties are almost confined to alcoholimetry for the purposes of the Excise, while among Public Analysts are some of the most eminent chemists of the day. No such jealousy is felt in regard to the distinguished men who act as chemical advisers to the Home Office.]

Sec. 23. Any person convicted by any J.s may appeal to next C.G. or Q.S. held for the same place, on entering within three days, with two sufficient sureties, into his recognizance to abide by the decision of the court and to pay the costs.

Sec. 24. A person desiring to set aside a conviction by the exemptions under §§ 5, 6, 8, must prove the same to the Court.

Sec. 25. If the defendant can prove to the Court that he bought the article in the same state as he sold it, and with a written warranty which he had no reason to doubt, he shall be discharged, but shall be liable to pay the costs incurred by prosecutor, unless he had given him previous notice of his intended defence.

Sec. 26. Penalties recovered by private prosecutors shall be appropriated as laid down by S.J.A., but those by officers of the authority appointing the analyst shall be paid by them to the authority and applied to the expenses of executing the Act.

Sec. 27. The penalty for forging a certificate or warranty, or uttering the same knowing it to be forged, is imprisonment

< 2½ years with hard labour. For wilfully misapplying a certificate or warranty given for some other article or for giving a false warranty in writing, or a label falsely describing the article sold, a fine < £20.

Sec. 28. Nothing in this Act shall interfere with proceedings by indictment, or with contracts, provided that if the person convicted can prove that the article was sold to him as of the nature, &c. demanded by the purchaser, that he had no reason to doubt the description, and that he sold it as he received it, he may recover from the person supplying him, in addition to any other damages, the amount of the penalty and costs incurred by him in both actions; the defendant in the latter action being, however, at liberty to prove that the conviction was wrongful, or the amount of costs awarded or claimed excessive.

Sec. 30. All tea imported shall be examined by persons appointed by the Customs and approved by the Treasury, and if necessary analyzed by analysts so appointed. If found to be mixed with exhausted leaves or other substances, it shall be delivered only with the sanction of and under conditions imposed by the Comm. of Customs, but if, in the opinion of the analyst, unfit for human food, it shall be forfeited and destroyed, or otherwise disposed of as they may direct.

Sale of Foods and Drugs Act, 1879.

A short amending Act (1879) providing § 6, that the minimum strength of brandy, whiskey, and rum, be 25° under proof, and of gin 35°. Also § 3, that a sample of milk may be taken "at the place of delivery," *i. e.* in the street as well as in the shop.

SALE OF FOOD AND DRUGS ACT, 1899 (62 & 63 Vic. c. 51).

[Intended primarily for the protection of genuine Dairy Produce.]

Sec. 1. Any one importing into U.K. (*a*) *margarine* or *margarine cheese*, not conspicuously so labelled, (*b*) adulterated or impoverished milk or cream, or butter, not described as such, (*c*) condensed milk, separated or skimmed, unless the tins, &c., be labelled *machine skimmed* or *skimmed milk*, in large and legible letters, (*d*) or other food to which the section may be applied by O. in C. without such clear description, shall be liable to a fine for the first offence < £20, for the second < £50, and for subsequent offence < £100. Preservative and colouring matters in quantities not injurious to health are not to be deemed adulterations. Prosecutions under this section to be undertaken by the

Customs Commissioners, and the portion for analysis (S.F.D.A., Sec. 14, 15) sent to Somerset House.

Sec. 2. The L.G.B. generally, and the Board of Agriculture in matters affecting agricultural interests, may appoint officers to act as under S.F.D.A., Sec. 13.

Sec. 3. And either Board, being satisfied that a L.A. has neglected its duties in this respect, may, after representation to the L.A., direct such officer to act, the expenses being defrayed by or recovered from such L.A. Subs. 5 requires evidence of competence by persons appointed as public analysts under S.F.D.A. [but L.G.B. had not in 1900 defined such].

Sec. 4. Empowers Board of Agriculture to define extent of permissible deficiency of any normal constituents of milk, cream, butter, cheese, or condensed milk.

Sec. 5. Extends provisions of Margarine Act, 1887, as amended by this, to margarine cheese, § 6. Such descriptions shall not be solely on labels or tickets, but marked or branded on the package, and printed without any other matter on every paper wrapper in which margarine or margarine cheese is sold in clear capital block letters not less than half-an-inch high.

Sec. 7. Every manufacturer of, or wholesale dealer in, margarine or margarine cheese, shall keep a register of quantity and destination of all sales and consignments, open at all reasonable times to any officer of B.A., and any fraudulent entry or method shall involve a fine of £10, and for a second or subsequent offence £50.

Sec. 8. Prohibits the sale of margarine containing over 10% of butter.

Sec. 9. Requires every one selling milk or cream in a street or public place to have his name and address conspicuously exposed on his vehicle, stall, &c., under a penalty < £2.

Sec. 10. Deals with taking of samples in course of transit.

Sec. 11. The words *skimmed* or *machine skimmed* shall be legibly printed in large type on every tin or vessel containing such condensed milk.

Sec. 12. Notices of mixtures must be so printed that they shall not be obscured by other words or matter.

Sec. 14. Extends Secs. 3 and 4 of the S.F.D.(A.)A., 1879, relating to taking samples of milk in course of delivery, to all other articles of food, provided that the purchaser or consignee consent.

Sec. 16. Obstructing or bribing an inspector to be punishable by a fine of £20 for the first, < £50 for the second, and < £100 for each subsequent offence.

Sec. 17. Revises the penalties for offences under the S.F.D.A. When the fine for first offence is £20, those for the second and subsequent offences shall be £50, and £100, and when > £50, the offence involving "personal act, default, or culpable negligence," for which the Court deems a mere fine insufficient penalty, the offender shall be liable to imprisonment < three months. [Under S.F.D.A., 1875, the penalties for manufacture or sale of articles so adulterated as to be "injurious to health" (= ? poisonous), Sec. 3, are a fine < £50 for the first offence, and imprisonment with *hard labour* < six months; for impoverishment, substitution, or fraudulent treatment not so injurious, Secs. 6, 7 and 9, a fine < £20; and for refusal to sell or obstruction < £10. N.B.—The money penalties are increased, but Sec. 3 of the principal Act holds good for the major offences.]

Sec. 18. When an article is exposed for sale in tins or packets duly labelled, the vendor shall not be required to open the same or sell the article otherwise.

Sec. 19. Repeals Sec. 10 of S.F.D.A., 1879 (the "Margarine Act"). Proceedings must be taken within twenty-eight days of the purchase; the summons must give name of prosecutor, and particulars of offence or offences, with a copy of analyst's certificate, and shall not be made returnable within fourteen days from service. This, subs. 1, is not limited (as was Sec. 10 of S.D.F.A., 1879) to perishable articles, but applies to prosecutions in respect of sales only, and not to those for false warranty. By sub. 2 applying to *all* prosecutions under S.F.D.A. Acts, the period of seven days between service and return of summons is extended to fourteen, and the service of copy of analyst's certificate is required.

Sec. 20. Amends Sec. 25 of S.F.D.A., 1875, and provides, *inter alia*, that (sub. 5) when defendant vendor has been discharged on the strength of a warranty received with the goods, further proceedings thereon may be taken before a Court having jurisdiction in the district where the sample was purchased for analysis, or in that where the warranty was given. [Facilitating prosecution of the original offender by dispensing with the necessity for a change of venue.] Sub. 6. Penalty for false warranty whether given by principal or agent, in writing, for first, second, and subsequent offence, fines < £20, < £50, and < £100 respectively, unless the defendant satisfy the Court that he had reason to believe the statements therein to be true. [*Onus probandi* transferred to defendant; prosecution not being required (as by S.F.D.A., 1875, Sec. 27) to prove that he had reason to believe them false.]

Sec. 21. Cfr. Sec. 22, 1875.

Sec. 22. Cfr. Sec. 18, 1875.

RIVERS POLLUTION ACT, 1876.

Sec. 2. Prohibits putting, or causing or knowingly permitting to be put, or to pass into any stream any solid refuse, rubbish, waste, or filth so as, singly or in combination with like acts of the same or other persons, to pollute the same, or to interfere with its flow, though each single act be insufficient to do so.

Sec. 3. Prohibits the causing or permitting of any solid or liquid sewage to pass into any stream, except through a sewer or channel made and used prior to the passing of the Act, provided also that the court be satisfied that the "best practicable and available means" are employed to render it harmless.

L.G.B. may after L.I. suspend action for such time as they think fit, and in the case of a S.A., renew the suspension if necessary to enable them to decide on and adopt the best means of purifying their sewage.

No person shall be held guilty of an offence for passing his sewage into any stream through a sewer belonging to a L.A., and with their sanction, but (56 & 57 Vic. c. 31) the L.A. itself shall be deemed knowingly to permit such pollution.

Sec. 4. Prohibits, in like terms and with the like saving clause as to purification, the discharge into a stream of "any poisonous, noxious, or polluting" factory waste or liquid.

Sec. 5. Prohibits in like manner and with same saving clause discharge of such liquid or solid matters from mines.

Sec. 6. Provides that proceedings under this Act shall be taken only by a S.A., and with consent of L.G.B., but if the S.A. refuse to apply to L.G.B., the L.G.B. may, on complaint of any person aggrieved, and after a local inquiry, direct S.A. to take proceedings. The L.G.B. shall not authorize proceedings unless satisfied that means exist for remedying the nuisance without serious detriment to local industries. [By R.P.A. 1898, L.G.B., and S.S. for Scotland, may act jointly under P.O. in case of rivers partly in each country.]

Any person against whom proceedings have been sanctioned by the L.G.B. shall have the right to be heard in objection thereto, by himself, agents, or witnesses before the L.A. ; and when nevertheless the L.A. have taken proceedings, no other L.A. shall institute such until he have failed, within reasonable time, to carry out any order of the Court.

Sec. 7. A S.A. shall afford facilities to manufacturers to discharge their wastes into their sewers, provided such liquids be not of a nature to injure the sewers, or unfit the sewage for disposal on land, or for sale or disposal otherwise, or be injurious to the health of the neighbourhood, or in excess of the capabilities of the sewers, or where such discharge would contravene the order of any court respecting the sewage.

Sec. 8. A S.A. may enforce the Act against persons without their district in respect of streams within the same. Subject to restrictions in § 6 (*re* mines), proceedings may be instituted by any person aggrieved.

Sec. 9. The Lea Conservancy Board shall within the area of their jurisdiction have all the powers of S.A.s to the exclusion of all other L.A.s, and also enforce provisions of their own Act, *re* "Protection of Water," in the County Court where the offence is committed, subject to those relating to summary orders and appeals contained in this (R.P.A.) Act.

Sec. 10. Offences against this Act, whether of commission or of omission, may be dealt with summarily in the County Court, which may insert in their order any conditions of time or action they think fit, and may suspend the same on satisfactory promise of compliance. They may also take opinion of experts as to the "best possible means" of obviating the nuisance.

The penalty for non-compliance with order of Court shall be a D.P. < £5, payable to complainant or other person as the Court may determine; and in default for a period not less than a month, or such time as the Court may prescribe, the Court may appoint a person or persons to carry out the order at the expense of the offending party.

Sec. 11. Either party may appeal from County Court to H.C.J., as herein provided.

Sec. 12. Certificate of I. of L.G.B. as to the "best possible means, &c." shall be conclusive evidence, but shall not continue in force for more than two years, after which it may be renewed for the like or a less period. (*b*) Any person aggrieved by grant or refusal of such certificate may appeal to L.G.B. (*c*) All expenses of certificate to be paid by applicant, and of appeals as L.G.B. decide.

Sec. 13. Proceedings under this Act shall not be taken until after two months' notice in writing, or while other proceedings for the same offence are pending.

Sec. 14. L.G.B. may make orders as to costs of inquiries, which orders may (under § 12 *c*) be made rules of H.C.J.

Sec. 15. In such inquiries I.s of L.G.B. shall have the same powers as to evidence, &c. as under P.H.A. 1875

Sec. 16. The powers given by this Act shall be cumulative, without prejudice to others.

Sec. 17. It shall not affect lawful rights of impounding or diverting water, nor

Sec. 18. interfere with rights, &c. given by the Thames and Lea Conservancy and Navigation Acts, or those relating to the M.B.W., or Acts amending the same.

Sec. 19. Nor shall it be an offence when any L.A., U.A., or R.A. has been empowered or required by Act of Parliament to discharge sewage into any sea or tidal waters.

Sec. 20. "Stream" includes the sea to such extent and tidal waters to such point "as L.G.B. after L.E. may determine." Also all rivers, streams, canals, lakes, &c., except such watercourses emptying directly into the sea used mainly as sewers, at the time of the passing of the Act, and tidal waters determined by L.G.B. not to be streams.

EPIDEMIC AND OTHER DISEASES PREVENTION ACT, 1878.

(Amends § 134 of P.H.A.)

Sec. 2. "Whenever any part of England or Ireland appears to be threatened with or affected by any formidable epidemic, endemic, or infectious disease," the L.G.B. E. or I. may make Regs. "for (1) the speedy interment of the dead; (2) for house to house visitation; (3) for provision of medical aid and hospital accommodation; and (4) for the promotion of cleansing, ventilation, and disinfection, and for guarding against the spread of disease." For these purposes L. and S.A. may borrow money from the P.W.L.C. in England and the B.P.W. in Ireland, as under the P.H.A. and P.H.(I.)A., which loans may be made without previous notice and inquiry, if L.G.B. deem the necessity urgent.

CLOSURE OF PUBLIC ELEMENTARY SCHOOLS.

New Code, 1882, Art. 98. The managers of a P.E.S. *must* comply with any notice of the L.S.A., either (1) to close the school for a specified time, or (2) to exclude certain scholars with a view to prevent the spread of infectious disease. If, however, they consider the notice unreasonable, they may appeal to the Educational Department. No loss of grant follows the failure to meet 400 times in the year in consequence of such closure.

FACTORY AND WORKSHOP ACT, 1901.

Sec. 149 and Sch. VII. define and enumerate F.s and W.s. F.s are textile and non-textile, and, quarries, &c. excepted, are places where steam, water, or other power is employed; W.s those where manual power only is used. A "tenement factory" is one the parts of which are separately occupied by different persons, each being in law a separate factory. Workshops are places not being factories to which the employer has access; tenement workshops those where two or more persons work on their own account; and domestic workshops those forming part of a dwelling-house and used by the family for sleeping.

Sec. 1. (1) Every F. and W. shall be kept (*a*) clean and (*b*) free from effluvia from drains, w.c.s, &c., (*c*) not overcrowded (*vide* Sec. 3), and (*d*) so ventilated (*vide* Sec. 7) that gases, vapours, dust, &c., produced therein shall be rendered so far as practicable harmless. (2) Sec. 91 P.H.A. shall not apply to F.s as defined by this Act. (3) All inner walls, ceilings, stairs, &c., shall, if not oil painted or varnished once in seven years, be limewashed, or if so painted, be washed with hot water and soap once in every fourteen months [a year is intended, but a margin allowed to avoid interruption of work when inconvenient], unless (4) specially exempted by S.S.

Sec. 2. (1) Sec. 91 (*b*) to apply to every F. and W. except those to which Sec. 1 of this Act applies, but (2) P.H.A., Sec. 91, applies to all workshops within meaning of that Act. (3) When on certificate of M.O.H. or S.I. it appears to D.C. that any workshop needs cleansing, D.C. shall give written notice to O. or *O.*, who (4) failing to comply within the time specified, shall be liable to D.P. < 10*s.*, or D.C. may do the work, recovering expenses from *O.*

Sec. 3. (1) Defines overcrowding as less than 250 cubic feet per head for persons working at same time, or during overtime 450 cubic feet, but (2) where other illuminant than electric light is used, or for particular industries, and (3) for domestic workshops, S.S. may order greater cubic space. (4) The permissible number of workers shall be posted in each room.

Sec. 4. (1) S.S., if dissatisfied with action of D.C., may authorize a F.I. to act for a specified time, with all the powers *ad hoc* of D.C., and to recover expenses from D.C. if not recovered from the actual offenders.

Sec. 5. If it appear to the F.I. that a remedy for any act, default, or condition in a F. or W. be provided for by the P.H.A., but not by this Act, he may (2) take with him the M.O.H. or S.I. for the purpose, and (1) shall inform the D.C., who must inquire and take action thereon, reporting result to the F.I., or (3) if they fail to do so within one month, he may take proceedings, recovering his expenses from D.C. if not from the offenders, except in cases of unsuccessful proceedings.

Sec. 7. (1) Sufficient means of ventilation shall be provided and ventilation maintained in every room of a F. or W., and (2) S.S. may prescribe standards for each class of F. and W. (3) Contravention of same to be dealt with under P.H.A., Sec. 91, but (4) *O.* may apply to C.S.J. for the payment by O. of all or part of the cost of providing means.

Sec. 9. (1) Every F. or W. to be provided with sufficient w.c.s and s.c.s separately for the sexes, (2) in numbers prescribed by S.S. (4) This section not to apply to London or places where P.H.(A.)A. 1890 is in force.

Sec. 73. (1) Every medical man called to see a case of lead, arsenic, phosphorus, or mercury poisoning, or of anthrax, contracted in a F. or W., shall, if it be not already reported, notify the chief I. of F. at the Home Office of the same (2) under a penalty of £2, and also (3) the F.I. and certifying surgeon of the district. (4) S.S. may add other diseases.

Sec. 97.—*Bakehouses.* (1) No (*a*) w.c., &c., to communicate directly with or (*c*) drain connected therewith, to open into a bakehouse, or (*b*) w.c. to be supplied from same cistern, (2) under a penalty for letting, occupying, or suffering to be occupied, < £2, and a D.P. < 5*s*.

Sec. 98. (1) Penalty for occupying a bakehouse unfit in opinion of D.C. on sanitary grounds, for first offence < £2, and for subsequent < £5. (2) C.S.J. may order alterations to be completed within fixed time under D.P. < £1.

Sec. 99. *Id. quod.* Sec. 1 (3), but substituting 6 for 14 months.

Sec. 100. No adjoining room to be used for sleeping unless separated by partition from floor to ceiling, and with outer window of nine square feet, opening to half its extent. Penalty for first offence < £1, for subsequent £5.

Sec. 101. Prohibits underground bakehouses, *i.e.* (3) the floor of which is three feet or more below level of footway in street or adjoining and nearest ground, unless (1) used before passing of this Act, and (2) after Jan. 1, 1904, (4) unless certified by D.C. as suitable in construction, lighting, ventilation, and every respect. (5) This section to be read into P.H.(L.)A. Sec. 26. (7) *O.* may within twenty-one days appeal to C.S.J. against refusal of certificate by D.C., when the court, if satisfied, may grant one. (8) *O.* may proceed as under sec. 7 (4), or court may determine lease.

Sec. 102. The provisions as to retail bakehouses shall be enforced by D.C., not by F.I., and M.O.H. shall have all legal powers, *ad hoc*, of F.I. [N.B.—See also pp. 128, 129.]

Sec. 107. (1) In certain trades specified by S.S. the *O.* of every F. or W., and contractor employed by him, shall keep on forms prescribed by S.S. lists of all persons employed by him outside of the F. or W., and on or before Feb. 1 and Aug. 1 shall send them to D.C. (2) D.C. shall examine lists, and send names and places of employment of all workers outside of their district to the proper D.C. (3) All these lists, original and communicated, shall be at all times open to inspection by any F.I. and authorized officers of the respective D.C.s. (4) For the purposes of this section any place where work is given out shall be deemed a workshop, and the employer or contractor its *O.* (5) Penalty for first offence < £2, and for subsequent < £5.

Sec. 10. (3) In classes of works specified by special order of

S.S., if (1) D.C. give written notice to *O.* of a F. or W., or his contractor, that the place is dangerous or injurious to health, and he continue after one month to give employment there, he shall be liable to a fine < £20 ; (2) *id. quod.*, sec. 107 (4).

Sec. 109. An employer causing or allowing wearing apparel to be made, repaired, or cleaned in a house or a building occupied therewith, where there is a case of scarlet fever or of smallpox, shall be liable to a fine < £10, unless he can prove that he did not and could not know of it.

Sec. 110. (1) If any inmate of a house is suffering (5) from a notifiable *I.D.*, (1) the D.C., or (3) in case of urgency any two or more members, on the advice of the M.O.H., (1) may make an order forbidding any work connected with (5) the making, finishing, repairing, cleansing, &c., of any article of apparel (1) to be given to any person living in that house or in any specified part thereof, and serve such order on the *O.* of any F. or W., or place where such work is given out, or on his contractors. (2) If the patient have been removed the order shall be for a specified time, or the place be disinfected and other precautions taken to the satisfaction of the M.O.H.

Sec. 125. For their duties under this Act D.C.s and their officers shall have all the powers of F.I.s.

Sec. 131. Every D.C. shall keep register of all workshops in their district.

Sec. 132. The M.O.H. in his annual report shall report specifically on F.s and W.s, and send a copy of the report or of so much of it to S.S.

Sec. 133. When a M.O.H. becomes aware that any woman, young person, or child is employed in a workshop where no abstract of the Act is affixed as required, he shall inform the F.I. of the district.

Sec. 154. D.C.s to include Councils of county boroughs and boroughs.

Sec. 155. Powers hereby conferred on D.C. are in addition those they possess under P.H. and other Acts.

N.B.—This Act, repealing among others those of 1878 and 1883, was passed after the first part of the work had gone to press ; but the provisions with which the Health Officer is concerned are, save in greater detail and stringency, unchanged, and those referred to in pp. 127—129 are now numbered as under—

1878.		1901.	1883.		1901.
Sec. 3	=	Sec. 1 (1)	Sec. 15	=	Sec. 97
,, 4	=	,, 5	,, 16	=	,, 98
,, 33	=	,, 1 (3)	,, 17	=	,, 102
,, 34	=	,, 99	,, 18		
,, 35	=	,, 100			

METROPOLIS LOCAL MANAGEMENT ACT, 1855.

[In this Act the L.C.C. shall be read for the M.B.W.]

Sec. 68. All sewers (except the main sewers, Sched. D), with all things appertaining thereto, and all rights of way and passage are vested in the L.A., as are all such as shall be made in each S.D. other than main sewers.

Sec. 69. Every L.A. shall maintain and repair all sewers vested in them (except such as they shall close or discontinue), with all diversions and alterations thereof, and all things thereto appertaining; and shall *cause* all banks, wharves, docks, and defences abutting on any river, &c. to be raised, repaired, or altered as may be necessary for the protection of their districts from inundation; they may carry such sewers through, across, or under any road, street, or land, and any cellar or vault under a street or footway, giving compensation for damages; they may close or alter any sewer under their control, provided that no new sewer be made without the previous approval of the M.B.W. = L.C.C., and that no sewer be closed without the provision of another equally effective, and that no nuisance be caused, or premises deprived of the means of disposal of its sewage. They may alter or adapt private drains, if necessary, provided their efficiency be not thereby impaired. [It has been ruled the cost of reconstruction of private drains previously sufficient and sound, shall, when necessitated by alteration in the level or direction of the sewer, be borne by the L.A.]

Sec. 70. When any party is liable by law to maintain and repair any sewer, bank, &c., and the L.A. deem it expedient to make more extensive alterations of the same, they *may* assess the said party for so much as would have been required for the necessary repairs, and charge the residue of the expenses to the district or persons who would have been liable if the said party had not been so in law; but nothing in this Act shall affect the legal liability of such parties to pay the whole cost.

Sec. 71. Every L.A. shall by trapping, ventilating, and all practicable means prevent effluvia from sewers, gulleys, &c., in their district.

Sec. 72. And cause all sewers, &c., to be so constructed and cleansed as not to be nuisances, for which purpose they may construct above or under ground all requisite works or machinery.

Sec. 73. If any house whenever built be found unconnected or insufficiently connected with a sewer; and there be one within 100 feet of any part of such building and at a lower level, the L.A. may require the owner to make such connection; the drains, with all branches, impervious surfaces, traps, gulleys, sinks, water supply, and all accessories and things belonging thereto, being planned and constructed with the approval and under the inspection of the officers of the L.A., who may require any reasonable change in or addition to the works, as fuller knowledge obtained during construction may demand, and should the owner refuse or neglect to begin such works for 28 days from delivery of notice in writing, or thereafter fail to complete with reasonable dispatch, the L.A. may execute the work, recovering the cost.

Sec. 74. When there is a sufficient sewer within 100 feet of any part of a block of contiguous houses, the L.A. *may*, if they deem it conducive to economy or efficiency, order their combined drainage.

Sec. 75. No house shall be built or rebuilt, or, if built, shall be occupied, unless provided with drains and all things connected therewith, and water supply be such as to satisfy the officers of the L.A., as sufficient for all floors and parts of the premises, and the drains be connected with the sewer, or if there be none within 100 feet, then with such cesspit as the L.A. shall direct; and if in rebuilding any house the ground-floor be found too low for proper drainage it shall be raised.

Sec. 76. Before beginning to dig for the foundations of any house or building to be built or rebuilt, or for laying any drain for direct or indirect communication with a sewer, notice in writing shall be given to the L.A., who within seven days shall make an order as to the level of the foundations and the level, direction, size, materials, &c., of the drains, with all traps, gulleys, water service, and things connected with the same; and in default of such notice, or if the work be carried out in any way contrary to the orders and regulations of the L.A., they may enter on, demolish, alter, or add to such work as may be necessary, recovering the cost from the owner.

Sec. 78. The L.A. may, if they think fit, construct so much of any private drain and of its connection with the sewer as shall involve opening up of any street or public place, recovering expenses from the owner.

Sec. 79. L.A. may arrange with O. or *O.* to construct at his expense the whole or any part of any public drain.

Sec. 82. Sec. 84.	P.H.(L.)A., § 40.
Sec. 83.	P.H.(L.)A., § 42.
Sec. 85.	P.H.(L.)A., § 41.
Sec. 86. Sec. 87.	P.H.(L.)A., § 43.

Sec. 98. L.A. may from time to time cause any street or part thereof to be paved, repaired, raised, or lowered, the gutters made or altered, as they think fit; also when necessitated by such alterations, change the course or depth of the water or gas mains, provided the consent of the companies be obtained.

Sec. 99. Provided always that when the freehold of any court, passage, or public place, not being a thoroughfare, is vested in the owner of the houses adjoining, the cost shall be borne by the owners.

Sec. 100. The owners of such places shall, if required by the L.A., pave, repair, drain them, and maintain them in a condition satisfactory to the L.A., and failing to do so within notice shall be liable to a fine < £5.

Sec. 116. Every L.A. has full power to water streets when and as often as they may think fit.

Sec. 118. L.A.s may appoint and pay crossing-sweepers, bearing a distinctive badge.

Sec. 135. Main sewers, with all things appertaining, are vested in the M.B.W. = L.C.C., who may construct new main sewers, sewerage works, &c.

Sec. 137. And may declare other existing sewers to be main sewers, taking over the control of the same.

Sec. 138. While to secure the efficient sewerage of London they may from time to time issue general or special orders to the L.A.s for their guidance in the construction and maintenance of the sewers in their districts. [Cf. M.M.(A.)A., § 83.]

Sec. 204. No building shall be erected over, under, or in any sewer or main sewer without previous written consent of the L.A. or M.B.W. = L.C.C.

Sec. 205. "No scavenger or other person" shall sweep or pass any soil, rubbish, filth, or any other thing into any gulley, drain, sewer, dock, or the river Thames under penalty < £5 for every such offence. ["Other things" mean presumably insoluble solids, for the L.A.s discharge snow into the sewers and the Thames.—E. F. W.]

Sec. 208. Sec. 209.	P.H.(L.)A., §§ 115, 116.
Sec. 211. Sec. 212.	P.H.(L.)A., §§ 125, 126.

Sec. 216. Expenses for improvements, pavings, &c., recoverable from private persons may be paid by instalments extending over < twenty years, with interest at < 5 %.

METROPOLIS LOCAL MANAGEMENT AMENDMENT ACT, 1862.

Sewers and Drains.

Sec. 44. Owners may, with approval of L.A., construct sewers and drains on their own lands, and at their own expense, but L.A. may contribute thereto.

Sec. 45. In every case L.A. shall submit plans of new sewers to M.B.W., and shall not begin the work till approved.

Sec. 46. L.A. shall give three clear days' notice to M.B.W. of intended connection of a sewer or drain with a main sewer, and do the work to their satisfaction.

Sec. 47. Private parties before connecting drains with sewers of L.A. must obtain their written approval.

Sec. 48. L.A. must obtain the same from M.B.W. before connecting sewer with main sewer.

Sec. 49. Plans to scale must be deposited with L.A. seven clear days before any work is begun in connection with any sewer of M.B.W.

Sec. 50. No plans of sewers approved by M.B.W. may be abandoned or altered without their consent, nor any existing sewer without consent of L.A.

Sec. 51. If any sewer approved by M.B.W. be not begun within twelve months, a fresh application must be made.

Sec. 52. Cost of construction of new sewers shall be apportioned among O.s of houses and lands abutting on street as L.A. may think fit. Such estimates to include all accessory and incidental expenses, and be payable at discretion of L.A. before, during, or after completion of work in one sum or spread over < 20 years with interest, and be recoverable by action at law or summarily before J.P. as L.A. elect.

Sec. 53. Where O. or *O.* have paid sewers rate, though there has been no sewer, or only an open sewer, L.A. shall undertake so much of the expense as they deem just, levying and recovering the balance from O.s as under Sec. 52.

Sec. 54. Lands may be charged in less proportion than house property.

Sec. 55. If the actual cost be less than the estimated, the excess shall be repaid to O.s, but if it exceed the estimate, the additional expense shall be charged and recovered as before.

Sec. 56. L.A. may at their discretion defray out of sewers rate any part of cost of new sewer. [The apportionment of the expenses among the owners may be made on the rateable value of the houses or the length of frontage, and "flanks" may be charged at a lower rate than frontages, as in paving of streets.]

Sec. 57. Any person aggrieved by the act or default of the L.A. in respect of such work, may (subject to Sec. 211 of the M.M.A. 1885) appeal to the M.B.W.

Sec. 58. When it is found necessary for the completion of any sewerage works within the Metropolitan area, to carry such works beyond these limits, the L.A. must obtain the consent of the M.B.W. and of the L.A. into whose district they propose to enter; and if either refuse L.A. may appeal to a S.S. No L.A. shall construct any sewer within or without the Metropolitan area without the consent of the M.B.W. This section shall not apply to the Metrop. Main Sewerage Works.

Sec. 59. The provisions of Sec. 80 of the principal Act as to levying and recovery of expenses by L.A. from O.s shall extend to all sewers to be constructed within the metropolis other than those made by and vested in the M.B.W.; and to these also when houses are drained directly into them.

Sec. 61. If any person make and connect a drain with any sewer without the consent, or not in accordance with the requirements of the L.A., he shall for each such offence forfeit a sum of <£50, and the L.A. may cut off the drain or reconstruct it at his expense.

Sec. 64. Neglect or refusal to carry out works ordered by L.A. under §§ 73, 74, 76 and 85 of the principal Act, renders the offender liable to a fine < £5, and a D.P. < £2; or L.A. may themselves carry out the work and recover the cost summarily.

Sec. 65. Any person causing the commission of such act, or default by another, shall be liable to like penalties.

Sec. 66. When no part of a property is within 200 feet of a sewer, or it cannot conveniently be drained into any sewer, the L.B. may sanction a temporary drainage into a cesspit.

Sec. 68. Any person building on or over, or encroaching on, obstructing, or in any way interfering with a sewer vested in the M.B.W., or a L.A., shall forfeit to the respective authority a sum < £20 for each offence, and a D.P. < £5, in addition to the cost of removing the building or obstruction. Provided that this shall not apply to the maintenance or renewal of buildings under which a sewer has been carried, and which do not affect its efficiency.

Sec. 83. M.B.W. may make, alter and repeal B.L.s and regulations as to the construction, ventilation, flushing, &c., of sewers and drains by L.A.s, or any other persons. But this shall not apply to the City, save as to the main sewers.

M. M. Amend. Act, 1899, provides that no B.L. of L.C.C. shall require L.A. to submit plans in the case of repairs not altering the course, capacity, or purpose of the sewer, nor under any circumstances previous to the commencement of the work, if the case be clearly one of emergency in which delay would be prejudicial to the public health; it will then be sufficient to submit the plans within one week, when they must be completed as the L.C.C. shall approve.

PUBLIC HEALTH (SCOTLAND) ACT, 1897.

(*This Act is far in advance of the P.H.A.*, 1875, *and in some respects of the P.H.(L.)A.*, 1891, *with which its enactments for the most part correspond so closely, that where not otherwise stated, the references may be taken as equivalent to the text of the Scottish Act.*)

PART I. Introductory.

Sec. 3. Definitions. P.H.A. § 4 ; P.H.(L.)A. § 141.

Sec. 5. Authorities for executing the Act, L.G.B.(S.), C.C.s, and Town Councils.

Sec. 6. The L.G.B.(S.) may, *on written application from a Parish Council, or ten ratepayers in the district*, or from one of its own inspectors, institute an inquiry into the sanitary condition of a district. P.H.A. §§ 293—299.

Sec. 7. Authorize a special inquiry by one of its own members, or—

Sec. 8. Appoint Commissioners, not being members of the L.G.B.(S.), for the purpose of the inquiry. P.H.A. § 296.

Sec. 9. Expenses of witnesses may be allowed.

Sec. 10. Penalties for giving false evidence, or refusing to obey summons, for the first offence < £5 ; for each succeeding offence it may be doubled, but not > £20.

Secs. 12—14. L.A.s to have the powers and liabilities of corporate bodies, and may appoint committees of their own members for particular purposes. P.H.A. §§ 200, 201.

Sec. 15. Requires every L.A. to appoint one or more M.O.H.s and S.I.s, whose qualifications, tenure, &c., correspond to those laid down in P.H.(L.)A. §§ 106—109.

PART II., Secs. 16—43 contain the Sanitary Provisions.

Sec. 16. Defines nuisances as in P.H.A. § 91, and P.H.(L.)A. § 2, including things "dangerous" to health, and adding to those mentioned in the other acts, "well or watercourse," and "cemetery, graveyard," &c.

Secs. 17, 18. Duty of L.A. to inspect district for nuisances. P.H.(L.)A. §§ 1—10.

Sec. 19. Any person may report nuisance to L.A. P.H.(L.)A. § 3.

Sec. 20. Service of orders for abatement. P.H.(L.)A. § 4.

Sec. 21. Summary procedure in non-compliance. P.H.(L.)A. § 5.

Sec. 22. Procedure by L.A. when nuisance proved to exist. P.H.(L.)A. § 4.

Sec. 23. Form of Interlocutor and Interdict.

Sec. 24. Penalty for contravention of decree or interdict <£5, for the second offence < £10, and doubling for each successive offence, but not > £200, with a D.P. < 10*s*.

Sec. 25. Order when structural works are required. P.H.(L.)A. §§ 5, 6.

Sec. 26. Power of entry by S.A. P.H.(L.)A. § 10.

Sec. 27. S.A. may sell materials. P.H.(L.)A. § 9.

Sec. 28. Cf. P.H.(L.)A., § 43. L.A. may fill up foul ponds, ditches, &c., convert them into sewers, &c.

Sec. 29. L.A. may provide public s.cs. P.H.(L.)A. § 44.

Sec. 30. Penalty for injuring w.cs., &c., so as to become nuisances, < £5. P.H.(L.)A. § 15.

Sec. 31. Injury to w.cs. used in common. P.H.(L.)A. § 46.

Sec. 32. Offensive trades. P.H.(L.)A. § 19.

Sec. 33. L.A. to license slaughter-houses. P.H.(L.)A. § 20.

Sec. 34. L.A. may provide slaughter-houses.

Sec. 35. L.A. may make B.L. *re* pig-styes.

Sec. 36. Duty of L.A. on complaint of nuisance from offensive trade by M.O.H., Parish Council, or ten ratepayers, to report to sheriff. P.H.(L.)A. § 21.

Sec. 37. L.A. amenable for nuisance from collection of refuse. P.H.(L.)A. § 22.

Secs. 38, 39. Scavenging of highways and formation of Scavenging Districts.

Sec. 40. Purification of filthy houses. P.H.(L.)A. § 60.

Sec. 41. Closing of ditches on border of district. P.H.A. § 48.

Sec. 42. Collection of manure. P.H.(L.)A. § 36.

Sec. 43. Unsound food. P.H.(L.)A. § 47.

Sec. 44. I.D.(N.)A. to be enforced everywhere.

Sec. 45. *M.O.H. may enter and inspect premises where he suspects presence of D.I.D. Penalty for obstruction* < £2.

Sec. 46. L.A. to provide means for disinfection of clothing, bedding, &c. P.H.(L.)A. §§ 59, 61, and I.D.(P.)A. § 6.

Sec. 47. Deals with cleansing and disinfection of premises, &c. Cf. P.H.(L.)A. § 60, &c., and I.D.(P.)A. §§ 5, 15, 17, and *requires L.A. to provide "free shelter or house accommodation, with, if necessary, maintenance and attendance," for any occupants whom it deems necessary to remove meanwhile;* and for the purpose of this sec., "house" includes tents, vans, and any vessel in waters "within or *ex adverso* of any place within the limits of the L.A."

Sec. 48. Disinfection of bedding, clothing, &c. P.H.(L.)A. § 61.

Sec. 49. L.A. *may demand from laundries lists of customers during prevalence of I.D.*

Sec. 50. Throwing infected things into dust-bins, &c. P.H.(L.)A. § 62.

Secs. 51—53. Letting or vacating infected houses or rooms without disinfection or notice. P.H.(L.)A. §§ 63—65.

Sec. 54. Provides for removal to hospital of any "person suffering from any *D.I.D.* who is without proper lodging or accommodation" (P.H.(L.)A. § 66), or "*is so lodged that proper precautions cannot be taken for preventing the spread of the disease, or is lodged in a tent or van, or in a room occupied by others besides those necessarily in attendance on such person, or is on board a ship*," and authorizes any magistrate to "*direct the removal from the room or house . . . of all others not in attendance on him*," the L.A. "*providing suitable accommodation for such person or persons.*" Cf. P.H.(L.)A. § 66.

Sec. 56. Exposure of infected persons in any public place (P.H.(L.)A. § 68), including any "*hotel, church, or any place used in common by persons other than members of the family or household*," and *makes the holding or permission of wakes over persons dying of I.D. a penal offence.*

Sec. 57. Is new and important, imposing a penalty < £2 on any parent or person in charge of a child who is or has been suffering from an *I.D.*, or who resides in a house where such disease exists, or has existed within three months, or who permits such child to attend school without producing to the teacher a certificate from the M.O.H. (which he shall give without charge), or from any medical man, that the child is no longer infectious, and that the house and everything exposed to infection has been effectively disinfected, and imposes the same penalty on any teacher or person in charge of a school who knowingly permits such child to attend without such certificate.

Sec. 58. On infected persons, *or persons residing in infected houses*, milking cows or handling food is more explicit than P.H.(L.)A. § 69.

Sec. 59. On the use of public vehicles by infected persons. P.H.(L.)A. § 70.

Sec. 60. Empowers M.O.H. to inspect dairies, and the L.A. to prohibit the sale of milk (subject, however, to appeal to the Sheriff, subsec. 7) *absolutely*, not as it is absurdly restricted by P.H.(L.)A. § 70 and I.D.(P.)A. § 4, to those from which the disease has already spread, and to sale "within the district," by implication permitting its sale elsewhere !

Sec. 61. *Enables L.A. to require production of lists of customers of a suspected dairy.*

Secs. 62—64. Deal with bodies of persons dying of *D.I.D.*, as P.H.(L.)A. §§ 72—74.

Sec. 65. *Authorizes L.A. to make bye-laws for securing cleanliness, &c., and preventing overcrowding of public conveyances.*

Sec. 66. Enacts that any L.A. may, *and if required by the L.G.B.*, *shall* singly or conjointly with other L.A.s, provide and maintain hospitals permanent, temporary, *or portable* for persons suffering from *I.D.* Cf. P.H.A., 1875, § 131, P.H.(L.)A. § 75, but further extends to the provision of *houses of reception for convalescents and of persons who have been exposed to infection*, also, *in place of or in addition to such hospitals, of nurses to attend on such persons at their homes, with medical attendance and medicines*, and *no such hospital shall be erected until the site, plans, &c., shall have been approved by the L.G.B.*

Sec. 67. L.A. may provide ambulances. P.H.(L.)A. § 78.

Secs. 68—71. Deal with provision of mortuaries, &c., as P.H.(L.)A. §§ 88—91.

Sec. 72. Deals with B.L. as to houses let in lodgings, as P.H.(L.)A. § 94.

Sec. 73. With tents and vans used as dwellings. P.H.(L.)A. § 95.

Secs. 74—76. With underground dwellings. P.H.(L.)A. §§ 96—98.

Sec. 77. Authorizes L.A. to defray the cost of vaccination and *re-vaccination*.

Secs. 78—80. Correspond to P.H.A. §§ 130, 134, 135 on the action of L.G.B. in dealing with invasions of epidemic diseases.

Secs. 81, 82. Correspond to P.H.(L.)A. §§ 82, 84 on the same. Sec. 82 gives special powers of entry to L.A. Sec. 84 provides that while epidemic regulations are in operation *all overcrowded dwellings shall be subject to the provisions relating to lodging houses.*

Secs. 85, 86. Government officials to aid in enforcing epid. reg. of L.G.B., and these to be uniform throughout U.K.

Sec. 87. Penalty for obstruction or non-compliance < £100, with D.P. £5. P.H.A. §§ 30, 140 [£50 and £5].

Common Lodging Houses.

Sec. 89. Lodging-houses to be registered. P.H.A. § 76.

Sec. 90. No lodgers to be received until house have been inspected and registered. P.H.A. § 78.

Sec. 91. Evidence of registration. P.H.A. § 79.

Sec. 92. L.A. to make B.L. as to L.H. P.H.A. § 80.

Sec. 93. Copy of B.L. to be supplied to keeper.

Sec. 94. L.A. may require additional water supply. P.H.A. § 81.

Sec. 95. L.A. may require reports from keeper. P.H.A. § 83.

Sec. 96. L.A. may remove to hospital persons suffering from *any I.D.*

Sec. 97. Keeper to notify fevers, &c. P.H.A. § 84.

Sec. 98. S.I. to have free access at any hour. P.H.A. § 85.

Sec. 99. Reg. for cleansing L.H. P.H.A. § 82.

Sec. 100. A third conviction to disqualify keeper for < five years. P.H.A. § 88.

Sewers and Drains.

Sec. 101. Sewers to be vested in L.A. P.H.A. § 13.

Sec. 102. L.A. may acquire existing sewers by purchase, compensating any persons damaged thereby. P.H.A. § 14.

Sec. 103. L.A. to make, maintain, and cleanse sewers. P.H.A. § 15.

Sec. 104. L.A. must give three months' notice, and publish plans, &c., before commencing sewerage works without their district. P.H.A. § 32.

Sec. 105. In the event of opposition no work to be begun without sanction of L.G.B. P.H.A. § 33.

Sec. 106. On application of L.A., the L.G.B. may institute a L.I., and on report allow, disallow, or alter scheme of L.A. P.H.A. § 34.

Sec. 107. Protection of railways, canals, &c., crossed or affected by sewer, &c.

Sec. 108. Empowers L.A. to utilize sewage for agricultural purposes, or to contract for such use of it by others, under leases not exceeding twenty-five years, nor five years without sanction of L.G.B. P.H.A. § 27.

Sec. 109. Gives powers of entry on such works by officers of L.A.

Sec. 110. Gives all persons within the L.D. the right to drain into the sewers of the L.A. P.H.A. § 21.

Sec. 111. L.A. may permit persons without the district to drain into their sewers. P.H.A. § 22.

Sec. 112. Penalty for unauthorized connection with a sewer, closure of drain, and < £5.

Sec. 113. When the cost of any sewer or drain work exceeds £30, L.A. must obtain estimate from their surveyor.

Sec. 114. No building to be constructed over a sewer but by consent of L.A. P.H.A. § 26.

Sec. 115. All sewers and drains to be trapped.

Sec. 116. All factories, distilleries, &c., to deposit refuse in pond or reservoir, within their works if possible, there to be purified before being passed into sewer, river, lake, &c. The reservoir not to be drained into sewer. P.H.A. § 17.

Sec. 117. Interruption of free flow of sewer involves penalty < £10, and D.P. < 20*s*.

Sec. 118. Throwing a carcase into any river, lake, or other water, fine < £10.

Sec. 119. L.A. may, if it think fit, and with consent of Bd. of Trade and Com. of Woods and Forests, carry any sewer or drain below low-water mark.

Sec. 120. L.A. may compel any house, factory, or distillery without a drain to drain into nearest sewer, or construct a sewer for the purpose. P.H.A. § 23.

Sec. 121. L.A.s may combine for sewerage. P.H.A. § 28.

Sec. 122. Special drainage districts may be formed on petition of Parish Council, or ten ratepayers, in any L.A. not a burgh.

Sec. 123. Works for distribution and supply of sewage for agriculture to be "improvements" under Impr. of Lands Act, 1864. P.H.A. § 31.

Water Supply.

Sec. 124. Burghs subject to B. Pol. A., 1892, are under its provisions as regards water supply.

Sec. 125. A L.A. not a burgh may require water supply to any house. P.H.A. § 62.

Sec. 126. And may provide or acquire any sources or supplies of water, so long as they do not encroach on the area of any W.Co. authorized by Parliament. They may (1) supply water for payment or gratuitously; (2) supply surplus for manufacturers or public baths; or (3) may cause existing free supplies to be maintained, and supply water free to public baths and washhouses not conducted for profit. P.H.A. §§ 64, 65.

Sec. 127. Penalty for causing any water to be fouled by gas-washings < £5. P.H.A. § 68.

Sec. 128. To be sued for within six months.

Sec. 129. And a D.P. < £5.

Sec. 130. L.A.s may combine for water supply.

Sec. 131. L.A. not a burgh, may, on request of a Parish Council or ten ratepayers, with approval of L.G.B., but subject to petition to sheriff, constitute a special water supply district. There shall, notwithstanding L.G.(S.)A. 1889, be no appeal from the district committee to the L.G.B.

Sec. 132. Incorporates Water Works Clauses Act, 1847, and in certain cases Railway Clauses Consol. Act, 1845.

PART VII., Secs. 133—143. *Rating and borrowing powers.*

PART VIII., Secs. 144—145. *Acquisition of land.*

PART IX. *Legal proceedings.*

Sec. 146. Application to sheriff in default or neglect of L.A.

Sec. 147. Application to Court of Sessions, with approval of L.G.B. and of Lord Advocate, by summary petition on refusal or neglect of L.A.

Sec. 148. Procurator-Fiscal may sue by direction of L.G.B. and with approval of Lord Advocate.

Sec. 149. When nuisance arises in another district L.A. may call on L.A. of that district, and ultimately appeal to L.G.B.

Sec. 150. L.A. may require payment of expenses by *O.*, who may deduct same from rent.

Sec. 151. Penalty for wilful damage of works belonging to L.A. < £5.

Sec. 152. L.A. may appear by any member, officer, or person duly authorized. P.H.A. § 259.

Sec. 153. Recovery of penalties.

Sec. 154. Form of application to sheriff.

Sec. 155. No written pleadings allowed, other than petition and answer if ordered.

Secs. 156, 157. Appeals in certain cases.

Sec. 158. Justices not disqualified from acting by being members of L.A. P.H.A. § 258.

Sec. 159. Service of notices, orders, petitions &c.

Sec. 160. Proof of regs. of L.A. and L.G.B.

Sec. 161. One or more of joint owners may be proceeded against. P.H.A. § 255.

Sec. 162. *O.* obstructing O. in executing orders of L.A. liable to D.P. < £5. P.H.A. § 306.

Sec. 163. Penalty for violating orders or obstructing L.A. in executing the same < £5. P.H.A. § 305.

Sec. 164. Persons damaged by orders of L.A. to be fully compensated. P.H.A. § 308.

Sec. 165. No conviction to be voided for want of form or of previous notice, provided the delinquent have appeared or knew of the charge. Charge may be amended at any time, and proceedings adjourned for adequate cause.

Sec. 166. L.A. and L.G.B. not liable for irregularities of their officers.

Port Sanitary Authorities.

Secs. 172, 173. Constitution and jurisdiction of P.S.A.

Sec. 174. P.S.A. may, with consent of L.G.B., delegate powers to any L.A. within their district.

Sec. 175. Expenses of P.S.A.

Sec. 176. Proceedings by P.S.A. for obtaining payments due from L.A.s.

Shipping Regulations.

Sec. 177. Ships in waters within or *ex adverso* of district to be deemed in district of L.A.

Sec. 178. Also if within three miles of coast.

Sec. 179. Charges for M.O. attending sick on board to be paid by captain. P.H.A. § 138.

Sec. 180. L.A. may make B.L. for removing to hospital sick persons brought by ships. P.H.A. § 125, &c.

Miscellaneous.

Sec. 181. L.A. may make building B.L.s. P.H.A. § 157, &c.

Sec. 182. Penalty for making foundations of foul-made soil < £5, and D.P. < £2. P.H.(A.)A. § 25.

Sec. 183. Bye-laws of L.A.s. P.H.A. § 182.

Sec. 184. L.A. may impose penalties < £5, and D.P. < £2 for breaches of B.L. P.H.A. § 183.

Sec. 185. B.L. to be confirmed by L.G.B. after due publication and notice. P.H.A. § 184.

Sec. 186. B.L. must be always open to inspection and sent to every Parish Council in district. P.H.A. § 185.

Sec. 187. Evidence of B.L.s. P.H.A. § 186.

Sec. 188. These provisions as to confirmation, &c., of B.L. not to apply to regs. L.A. is competent to make *propriâ motu.*

Sec. 189. Nothing in this Act to prejudice or affect existing works for irrigation, water supply, navigation, purification of rivers, &c. Nor shall L.A. execute any works in harbours, docks, reservoirs, &c., without consent of persons entitled to tolls, &c. ; and these persons may, at their own expense, take up, alter, divert, or substitute others, for any culverts, sewers, drains, pipes, &c., constructed by L.A. which interfere with their own works. P.H.A. §§ 330—332.

All Government property shall be exempt from building B.L.s of L.A.s.

N.B.—In Scotland "house" and "tenement" have meanings the converse of those usually accepted here; not only self-contained dwellings in blocks or flats, but each room or pair of rooms let separately being a "house," and the whole building a "tenement."

CANAL BOATS ACT, 1877.

Sec. 1. No canal boat shall be used as a dwelling unless registered.

Sec. 2. L.G.B. shall make Reports as to registration, cleanliness, and prevention of *I.D.*

Secs. 4, 5. Empower S.A. to take steps for preventing spread of *I.D.*, and to detain a boat, and give power of entry.

L.G.B. has issued Regs., March 20 and May 17, 1878.

An after-cabin used as a dwelling must have at least 180, and a fore-cabin 80 cubic feet of *free* air space. If used for carrying offensive cargo there shall be between each cabin and cargo two water-tight bulk-heads, with interspace of at least four inches open above, and provided with a pump. Should any person on board be suffering from *I.D.* or *seriously ill*, master must notify at once to the S.A. of the place where the boat happens to be, and on arriving at destination to S.A. of that place also.

CANAL BOATS (AMENDMENT) ACT, 1884.

Sec. 1. Certificate of registration to cease to be of force in the event of any structural alteration affecting conditions on which it was granted.

Sec. 2. Imposes fine of £1 on master and owner for non-compliance with any regulations of Education Department.

Sec. 3. Every S.A. within whose district any canal or part of a canal is situate shall enforce all provisions of these two Acts and O.C.s thereon, and report in every January to L.G.B. proceedings under the Act during preceding year.

Sec. 4. L.G.B. to report annually to Parliament on proceedings under Act, and Inspections. To appoint special Inspectors who may enter any boat between 6 a.m. and 9 p.m., and inspect any part, detaining the boat so long as but not longer than is necessary. Master to produce his certificate, and render all information and assistance required under penalty for obstruction < £2.

Inspectors may hold local inquiries, call witnesses and papers, &c.

Sec. 5. Education Department to make regulations for instruction of canal boat children, and report annually to Parliament.

Sec. 6. Adds to sec. 3 of principal Act, that a boat must be "lettered, marked, and numbered," in a conspicuous position on *both* sides, or on the stern so as to be clearly seen from either bank.

DISEASES OF ANIMALS ACT, 1894.

Sec. 1. C.A. is B.A.

Sec. 2. L.A. to execute Act.

Sec. 3. L.A., in boroughs (with population at last census not under 10,000), the Borough Council, and in Administrative Counties the C.C.

Sec. 4. (1) Every person suspecting that he has a diseased animal shall (*a*) isolate it, and (*b*) inform a police-constable who (2) shall inform such person as the B.A. may direct.

Sec. 5. *Cattle Plague.*—A S.I. learning the existence of *C.P.* within ten days, shall forthwith (1) make and sign a declaration thereof; (2) serve a notice of the same on the *O.* of the premises, and (3) subject to the determination of the B.A. declare the same to be an *I.P.* Also (4) unless he deem it inexpedient, on all *O.s* of property within one mile, (5) declaring such to be an *I.A.* (6) He shall forthwith inform B.A., sending copies of his declaration and notices, and (7) the B.A. shall after L.I. (8) confirm or (9) amend or annul the declaration.

Sec. 6. The B.A. may on sufficient information and inquiry declare any place to be an *I.P.* or *I.A.*, and may alter the limits or declare it free.

Sec. 7. B.A. (1) Shall cause to be slaughtered (*a*) all animals affected with, or (*b*) exposed to infection; and (2) may such also as are suspected, or have been in an *I.A.* though not in an *I.P.* [subject therein to the regulations of the Treasury]; (3) paying as compensation half the original value of the affected, but < £20, and full value of suspected, but < £40.

[In the remaining sections I shall substitute for the longer phrases of the Act in respect of animals the terms "contacts" and "suspects" used by M.O.H.s of persons who have been, or are suspected of having been, exposed to infection.—E.F.W.]

Sec. 8. *Pleuro-pneumonia* and *Foot and Mouth Disease.*—On learning of the existence of *P.P.* within 56 days, or of *F.M.D.* within 10, the S.I. of the L.A. shall (1) forthwith make and sign a declaration thereof (2) serving notice on *O.* of the premises, which (3) shall, subject to the determination of the L.A., be deemed an *I.P.* (4) He shall forthwith inform the L.A., sending copies of declaration and notice. (5) L.A. shall then, with advice of V.I., and after inquiry, either (6) confirm his declaration, including, if they think fit, any adjacent land or premises within their district, and (7) with consent of the respective L.A.s in others also, or (8) may declare such places to be or to have become free. (9) L.A. shall forthwith report to B.A. the declaration of their S.I. and their action thereon; (*a*) what places or areas have been declared infected, and (*b*) if there be any fairs or markets therein, whether they should or should not be prohibited by O.C. (10) This section shall (subject to Sec. 21) have like effect when the animals are not in possession or control of O. (11) *Not less than* 56 days after declaration of *P.P.*, and not less than 14 nor more than 28 days in the case of *F.M.D.*, L.A. may with consent of V.I. declare place free. [The meaning of this is that, always supposing the disease to have ceased, no new cases having appeared, the withdrawal of the embargo on the place *must not* be entertained within 56 days of declaration of *P.P.*, or 14 of that of *F.M.D.*; but that while this *may* be indefinitely deferred in the case of *P.P.*, its expediency *must*, in that of *F.M.D.*, be considered when a month has elapsed.—E.F.W.] (12) Repeats Sec. 6.

Sec. 9. Repeats Sec. 7 and Sec. 8 (9), applying these to *P.P.* and *F.M.D.*

Sec. 10. B.A. (1) may make orders in accordance with provisions of this Act, in respect of other diseases than *C.P.*, *P.P.*, and *F.M.D.*; (2) declaring *I.P.s* and *I.A.s*; (3) amending and annulling such orders; (4) and declaring areas free; (5) such orders and declarations to be conclusive.

Sec. 11. Cattle shall not be moved into or out of an *I.P.* or *I.A.*, or within such area save as provided (1) as regards *P.P.* in Sched. I., Pt. I., and (2) *F.M.D.* in Pt. II. of the same.

Sec. 12. (1) When B.A. by order declare this section to apply to *any* disease, a circuit of half-a-mile radius around any *I.P.* shall be an *I.A.* subject to instructions by B.A.; (2) and cease to be so when the place is declared free. (3) B.A. may issue any public order respecting the same. (4) Overlapping circles shall be deemed to enclose on *I.A.*

Sec. 13. O. of infected animals may post notice excluding strangers, *i. e.* "persons not having by law right of entry," from his premises.

Sec. 14. (1) B.A. shall cause all animals affected with *P.P.* to be slaughtered, and (2) may also (*a*) suspects and (*b*) contacts, (3) giving as compensation for (*a*) affected three-quarters previous value, but < £30, and (*b*) for others full value < £40. (4) O. may require of B.A. to cause slaughter of contacts within 21 days. (5) Expenses to be borne by Cattle *P.P.* account of Great Britain.

Sec. 15. B.A. may (1) cause slaughter of (*a*) animals affected with *F.M.D.*, or (*b*) of contacts, (2) compensating to full value of (*a*) before illness, and of (*b*) before slaughter.

Sec. 16. B.A. shall have like powers in respect of *S.F.*, compensation to half value of affected animals, and full value of others, to be paid out of *P.P.* account for Great Britain.

Sec. 17. B.A. may for purposes of Act employ and pay (subject to approval of Treasury), as they think fit, additional inspectors, valuers, &c., from *P.P.* account.

[This account is provided from Parliamentary Grant < £140,000 per annum, with proceeds of sale of carcases, supplemented, if necessary, from local taxation.]

Sec. 18. Relates to this account.

Sec. 19. B.A. may provide by order for the slaughter, with compensation, of affected animals and contacts in other diseases.

Sec. 20. (1) B.A. may on paying compensation remove for observation or treatment any animal liable to be slaughtered. (2) The carcases of animals slaughtered by order of B.A. or L.A. shall belong to B.A. or L.A., and be by them buried, sold, or otherwise disposed of, any proceeds to be paid to credit of rates, but (3) any excess over amount of compensation paid to owner. (4) Carcases may be buried by B.A. or L.A. on any suitable part of the owner's land, or on unenclosed lands by B.A. or by L.A., with consent of B.A. (5) In case of insured animals, amount of compensation may be deducted by insurers. (6) L.A. shall keep such record of slaughtered animals as B.A. may direct. (7) B.A. or L.A. may refuse compensation wholly or in part if owner have violated this Act, or for foreign cattle diseased on landing.

Sec. 21. B.A. may provide by order for (1) animals found affected with *P.P.* or *F.M.D.* while (i.) exposed for sale, (ii.) in lairs, pens, sheds, &c., prior to exposure for sale, (iii.) in transit by land or water, (iv.) in wharfs, &c., for foreign cattle, (v.) in slaughter-houses, (vi.) on unenclosed lands, or (vii.) anywhere not in possession of owner, consignor, or consignee, (2) and for the consequences of their being so found. (3) Every such order shall have full effect notwithstanding any provision of this Act.

Sec. 22. B.A. may make orders, &c. (subject to and in accordance with provisions of this Act), for placarding the neighbourhood, for isolation of affected and separation of healthy animals, movements of animals and persons, and removal of carcases, fodder, litter, dung, &c., into, within, or out of infected area, and for disinfection and cleansing of places, persons, clothing, &c., and destruction, treatment, and disposal of carcases, fodder, &c., &c., likely to carry infection. The exposure for sale, detention in lairs, &c., and transport by land or water, in vehicles or by driving, and leaving on any unenclosed or insufficiently fenced land of infected or suspected animals or things whatsoever. The movement of healthy animals and isolation of newly purchased and removal of any fodder, litter, dung, &c., in *I.A.s* or elsewhere, and the legal or illegal seizure, detention, and disposal of diseased or suspected animals and responsibility of owner, consignor, and consignee. Valuation, compensation, and disposal of animals dying of diseases or slaughtered under the Act. Licensing drovers, holding fairs and markets, cleansing and disinfection of markets, sheds, lairs, and of vessels, vehicles, pens, &c., and prescribing methods of disinfection. For securing proper ventilation, food and water for, and the avoidance of needless suffering by, animals in transit by land or sea; prohibiting their transport by any particular vessel deemed unfit or for which penalties have already been recovered under these Acts. Marking animals, muzzling and control of dogs, seizure of stray dogs, and of other animals. Forms of notices, &c., securing uniformity of action among L.A.s.

Extension of definition of disease to include others, and of animal to any four-footed beast. With anything tending to secure the better execution of the Act.

Sec. 23. (1) Every railway company shall make at their stations such provisions as B.A. may direct for supplying, (2) at the request of consignor or person in charge, fodder and water to animals conveyed by them, (3) at a reasonable charge, or such as B.A. may direct, which shall be in addition to the fare for carriage, and summarily recoverable with costs from consignor or consignee. The company shall have a lien to that amount from either party on any animals conveyed by them. (3) If any animal be left in transit without water for 24 hours, or (5) such shorter time not less than 12 hours, as B.A. think fit to prescribe, the consignor and person in charge shall be guilty of an offence against this Act, unless they can prove that the request was duly made to the company.

Sec. 24. *Foreign Animals.*—Provisions of Sched. III., Pt. I. shall apply to all foreign animals excepting those, (1) the landing of which is for the time being prohibited by B.A., (2) or allowed without slaughter, (3) or intended for exhibition, breeding, or other special purpose provided for by Sched. III., Pt. II.

Sec. 25. B.A. may prohibit or place such restrictions on the landing of animals from any foreign country as they may think necessary for the exclusion of epizootic diseases.

Sec. 26. B.A. may exempt from exclusion, slaughter, or quarantine, animals from any given country, if satisfied as to the absence of contagious diseases, and the sufficiency of the sanitary regulations thereof. Provided that all such animals shall be subject in transit to any regulations and orders of B.A.

Sec. 27. B.A. may, notwithstanding anything in this Act or in their own orders to the contrary, permit by order the landing of particular animals [sec. 24, c.] under provisions of Sched. III., Pt. II.

Sec. 28. B.A. may alter or amend Sched. III. or make special regulations in respect of the Channel Islands and Isle of Man.

Sec. 29. Every order of B.A. shall be so soon as possible laid before both Houses of Parliament.

Sec. 30. (1) B.A. may make orders and reports naming, defining, and limiting the ports, and parts of ports for the landing of foreign animals, prohibiting or regulating their movements into, within or out of the same, regulating the inspection, examination, or slaughter of animals, foreign or not, in such ports, and the removal and disposal of fodder or anything likely to convey infection; the cleansing and disinfection of places and things, or distribution of such things within the prescribed area; for regulating the movement of persons therein, and the disinfection of their clothes; prescribing and regulating the seizure and detention of foreign animals, or of anything for the better effecting the purposes of the Act. (2) Notwithstanding anything contained in this Act, the B.A. alone can declare any port or part of a port an *I.P.* (3) When a port (*vide* subs. 1) and a L.D. coincide wholly or in part, B.A. may create or appoint an authority other than the L.A. for the purposes of this Act.

Sec. 31. Explains the mutual rights and obligations of B.A., C.C., and L.A. with regard to local committees.

Sec. 32. (1) L.A. may provide wharfs, sheds, slaughter-houses, &c., for landing and disposal of foreign animals, carcases, fodder, &c. [Cf. P.H.A., 1875, §§ 166, 167 and *sq.*] (2) The Markets and Fairs Clauses Act, 1874 (except §§ 6—9 and 51—60) shall be incorporated with this Act. (3) A wharf shall be a market within the meaning of that Act. (4) L.A. may make such charges for the use of the lairs, sheds, &c., as their bye-laws permit, (5) which shall be carried to a separate account for the purposes of Part III., and (6) make returns to B.A., by whom (7) they may be revised or reduced.

Sec. 33. L.A. may purchase, lease, or hire land for the purposes of § 32, or for the burial of carcases, if there be no land in possession of the owner, or waste land in the neighbourhood suitable for the purpose.

Sec. 34. (1) When a L.A. fails to execute or enforce provisions of this Act, or orders of B.A., the B.A. may appoint a person to carry out the same, (2) all expenses incurred by or on behalf of the B.A. to be paid by or recoverable from L.A. (3) on order of B.A., which shall be deemed conclusive (4) without prejudice to rights of B.A., or other authority to take any proceedings to compel L.A. to act.

Sec. 35. (1) Every L.A. shall appoint a sufficient number of I.s and officers for the purposes of the Act, determining their duties and salaries, and may revoke such appointments, (2) shall at all times have one V.I., and may appoint more, (3) and may remove any such I.s or officers for incompetency, neglect, or misconduct.

Sec. 36. Every L.A. and their I.s, &c., shall send to B.A. all returns, notices, &c., as B.A. may require.

Sec. 37. (1) Any order or regulation of L.A. may be proved by (i.) production of newspaper containing it, or (ii.) copy of order, &c., certified by clerk of L.A., (2) and shall be taken to have been made unless the contrary be proved, (3) provided that such only as are authorized by Act, or by order of B.A. shall be valid.

Sec. 38. Powers conferred on a L.A. or its officers may be exercised in its district only.

Sec. 39. (1) L.A.s whose districts adjoin or intersect one another may combine by agreement in writing (which may be varied or rescinded), for the exercise of powers under the Act by one of them, to be called the "administering authority," the expenses to be apportioned among them according to the rateable value of the "administering," and of the others, or "surrendering," authorities. (2) The latter to be deemed parts of the former for the purposes of the Act. (3) Expenses to be paid out of the local rates, (4) provided that when the latter is a Borough and the former a County, to which the Borough is assessed, the local contribution shall not be paid to the Borough. (5) L.A.s may also combine by agreement in writing to delegate their powers under the Act to a joint committee of such number, constitution and under such conditions as they may think fit [Cf. Sched. IV.], as if the committee were the L.A., and the combined districts the L.D., (6) apportioning all expenses by their respective rateable values. (7) Such agreement must be approved by B.A., and (8) the powers conferred thereby shall not include the making or levying of a rate.

Secs. 40, 41, and 42 are wholly financial.

Sec. 43. (1) The police of any county, district, or town, shall execute this Act and all orders of B.A., and may (2) without warrant arrest any person violating the same, and detain any animal, vehicle, boat, or thing relating thereto, and require it to be forthwith taken back to the place whence it was unlawfully removed, (3) also without warrant arrest any person obstructing or aiding obstruction. (4) Such persons shall be brought so soon as possible before a J.P., and if arrested without warrant detained no longer than is necessary for this purpose, and released on giving recognizances. (5) These provisions apply also to any person called to his aid by a constable. (6) The constable shall forthwith report in writing to his superior. (7) Nothing in this Act shall abridge or prejudice any power he may already possess.

Sec. 44. (1) An I. shall have all the powers of a constable, and (2) may at any time enter any land, dairy, sheds, &c., where he has grounds for suspecting disease to have existed within 56 days, that a diseased carcase has been kept, buried or otherwise disposed of, or that this Act or an order of B.A. has not been complied with, and (3) enter under like circumstances any pen, vehicle, vessel, &c., but (4) must, if required by the owner or person in charge, give his reasons for so doing in writing. (5) Certificate of V.I. shall be conclusive evidence of disease. (6) I.s of B.A. shall have like powers with those of L.A.s throughout England.

Sec. 45. An I. of B.A., (1) if satisfied of the violation of this Act, or of any regulation of L.A. on board any vessel in a port, may, (2) on giving written notice of his reasons, detain such vessel so long as B.A. may determine. (3) Cf. § 692 of Merchant Shipping Act, 1894.

Sec. 46. When a carcase washed ashore has been buried or destroyed by a "Receiver of a Wreck," with authority of the Board of Trade, the expenses shall be borne by, and recoverable from L.A., (2) but when thrown or washed from any vessel and buried or destroyed by L.A., the owner of the vessel shall be liable to the L.A.

Sec. 47. No fee, stamp duty, &c., shall be charged for any appointment, licence, certificate, &c.

Sec. 48. (1) No proof shall be required of the appointment or handwriting of any officer of B.A. or L.A. in proceedings under this Act. (2) Every notice shall be in writing, and (3) served on the person, left at his usual place of abode or business, or addressed there by post, (4) and save when sent by post, may be addressed to "Occupier," or "Occupiers."

Sec. 49. (1) B.A. may alter or revoke its orders, (2) which shall have like force with provisions of Act, (3) and be published in London Gazette, with date of issue and place where copies may be had. (4) Every order, licence, &c., sent by B.A. shall be published by L.A. at its own expense as B.A. may direct, and (5) the validity of the same shall not be affected by any defect or irregularity in the publication.

Sec. 50. B.A. not later than Mar. 31 to make return to Parliament of proceedings under Act for year ending Dec. 31 last.

Sec. 51. Fines for offences against this Act < £20, or if in respect of several animals < £5 for each, and for fodder, &c., < £10 for every half ton after the first half + penalty < £20 for the offence.

Sec. 52. Every person shall be guilty of an offence against this Act who (1 and 4) does anything prohibited, or (2 and 3) fails to do anything enjoined by this Act or by any order of B.A.; who obstructs any officer of the L.A., or fails (2) to give prompt notice of disease, (7) or throws a diseased carcase into any inland water or the sea within 3 miles from shore; and on a further conviction under the same subsection within twelve months, he shall be liable, at discretion of C.S.J. to imprisonment < one month, with or without hard labour, in lieu of fine.

Sec. 53. (1) Every person who shall knowingly and with intent to evade the provisions of the Act, or to defraud; or shall not be able to satisfy the Court that he did not know, and could not with due diligence have known the nature of his offence, viz. (i.) act without, or (ii.) on an expired or (iii.) imperfect or false licence, or (iv.) shall alter dates, names, &c., or otherwise counterfeit or falsify any order, notice, declaration, licence, &c., of B.A. or L.A., or (v.) make false declaration, or (vi.) pretences to obtain one, or (vii.) issues or makes such false in any particular, or (ix.) grants such illegally, or (ix.) uses or attempts to use one issued in blank, or (x.) obtains or seeks compensation on false pretences, or (xi.) without lawful authority digs up or attempts to dig up any carcase buried by order of B.A., L.A., or receivers of wrecks, or (xii.) uses any vessel, vehicle, or pen, &c., for purposes prohibited by order of B.A.,

(2) shall be liable on conviction at discretion of Court to imprisonment with or without hard labour < 2 months, in lieu of fine.

Sec. 54. Proceedings under this Act may be taken in C.S.J. according to 11 & 12 Vic. c. 43, except in proceedings under Customs Acts.

Sec. 55. Any person may appeal from C.S.J. to next practicable C.G.S. or C.Q.S. for the county or place, held not less than 21 days after decision appealed from, on his giving within 10 days written notice of his intention to clerk of C.S.J. and to the other party, with the grounds of his appeal, and within 3 days of such notice entering into a recognizance with two sureties before a J.P., conditioned personally to try the appeal. The Court may make an order or adjourn the appeal. This section does not apply to London or to proceedings under the Customs Acts.

Sec. 56. Landing, shipping, or attempting to land or ship animals, or things, in contravention of this or of the Customs Acts, involves forfeiture and proceedings under Customs Act.

Sec. 57. The *onus probandi* of (1) ignorance of existence of diseased animals in his possession, or of (2) having properly cleansed and disinfected premises, or of (3) the non-commission of any offence or neglect rests with the accused, who (4) may demand to be examined, and give evidence on his own behalf, and (5) notwithstanding any metropolitan police, or municipal corporation, or other Acts, a part of the fine < half may (except in proceedings under the Customs Act), at the discretion of the Court, be paid to the informer or prosecutor.

Sec. 59. Definitions—"Cattle" means bulls, oxen, cows, heifers, and calves.

"Animals" include cattle, sheep, goats, and swine.

"Disease" means cattle-plague, pleuro-pneumonia, foot and mouth disease, sheep-pox, and swine fever, under whatever names they may go.

"Veterinary Inspector" is one who is M.R.C.V.S.

"Foreign countries" are all beyond Great Britain and Ireland, and "foreign animals" those brought from such.

"Carcase" includes hide, horns, or any parts of a carcase.

[The remaining definitions are superfluous or redundant.]

Secs. 60—64, explaining the application of the Act to Scotland, and §§ 65—77 to Ireland, consist almost wholly of definitions and the substitution of equivalent or corresponding authorities, courts, procedures, officials, &c.

Sec. 78. Provides for the continuance, unless revoked by B.A., of all existing appointments, regulations, &c., under previous Acts, as if they had been made or ordered by B.A. under this Act.

Sec. 94. Gives short title "Diseases of Animals Act, 1894."

SCHEDULE II. deals with finance, viz. the *P.P.* accounts of Great Britain (See § 18) and of Ireland (§ 73).

SCHEDULE IV. defines the constitution and procedure of the Joint Committees authorized by § 39 of the Act.

SCHEDULE V. repeals all previous Acts of like nature, except § 34 of Contagious Diseases Animals Act, 1878, empowering Privy Council = B.A. to issue, subject to the provisions of this Act, orders for the regulation of cow sheds, dairies, and milk-shops; and §§ 90, 92 and 93 of the C.D.(A.)A. of 1886.

SCHEDULE I. PART I. Pleuro-pneumonia.

PART II. Foot and Mouth Disease.

[The provisions of this Schedule, the two parts of which are identical save in the names of the diseases, and may be extended by order of B.A. to any other infectious disease of domestic animals, apply to Infected Places and Areas in the United Kingdom, as SCHED. III. aims at preventing the introduction of such diseases from foreign countries.] Each part contains three clauses. (1) Cattle shall not be moved out of *I.P.* or *I.A.*, nor into an *I.P.*, unless already affected, and in cases excepted by order of B.A. (2) And in such excepted cases only on conditions prescribed by order of B.A. (3) Cattle may be moved by licence of L.A. into, within, or out of parts of *I.A.* not being *I.P.s*, such licence being granted only on conditions prescribed by B.A.

SCHEDULE III. FOREIGN ANIMALS.

PART I. *Slaughter.*—Foreign animals (1) shall be landed at a part of a port set apart by B.A., and (2) under such conditions as Commissioners of Customs may prescribe, and (3) shall not be removed alive from the wharf.

PART II. *Quarantine.*—Animals intended for exhibition, breeding, or other special purposes exempt (under § 26) from the foregoing provisions; shall (1) be landed at a part defined by B.A. as a "quarantine wharf," (2) under such conditions as B.A. may prescribe, (3) where they shall be kept in sheds set apart by L.A. or by owners of station, and approved by B.A., and (4) not removed thence except under conditions prescribed by B.A.; but (5) all provisions of the Act as regards disease, slaughter, compensation, and disposal of carcases shall apply to them.

[B.A. may by order suspend or modify these regulations in respect of the Channel Islands and Isle of Man, and with consent of Parliament, obtained as early as possible, in respect of any other foreign country. (Cf. §§ 24—28.)]

DAIRIES, COWSHEDS, AND MILKSHOPS ORDER, 1885.

Extends to England and Wales only, revoking Order of 1879.

Sec. 6. (1) Cowkeepers and dairymen to be registered by L.A., except such as make butter or cheese only and do not sell milk, and persons selling to their neighbours small quantities of milk of their own cows, not kept for trade. Such registration does not authorize the occupation of any particular premises.

Sec. 7. No one may begin to occupy as a D. or C.S. any buildings not so used prior to this order, unless he provide, to the satisfaction of the L.A., for the lighting, ventilation, air space, cleansing, drainage, and water supply, nor without giving one month's notice of his intention to the L.A.

Sec. 8. No one shall occupy as D. or C.S. any building whether so used previously to this order or not, if and so long as the said conditions "are not such as are necessary or proper for (1) the health of the cattle, (2) the cleanliness of the vessels, and (3) the protection of the milk from infection or contamination."

Sec. 9. No person suffering from any *D.I.D.* [including measles ?], or having recently been in contact [this should include association or proximity] with any person so suffering, shall milk cows, handle vessels, or take any part in the "production, distribution, or storage" of milk until all danger of infection is past.

Sec. 10. No w.c., e.c., p., c.p., or u. shall be allowed, after one month's notice from L.A., to be in direct communication with or ventilate into any dairy or milk-store.

Sec. 11. No D. or M.S. shall be used as a sleeping-room, or any purpose incompatible with the purity of the milk.

Sec. 12. No swine may be kept in a C.S., &c.

Sec. 13. L.A. may from time to time make regulations for (*a*) inspection of cows, (*b*) prescribing and regulating the sanitary arrangements of D. and C.S., (*c*) securing the cleanliness of M.S. &c., and vessels, and precautions against infection.

Sec. 14. (1) Such regulations shall be advertized in local newspapers, a copy having been one month previously submitted to L.G.B. for approval.

Sec. 15. Milk from a cow suffering from disease (*i.e. C.P.*, *P.P.*, and *F.M.D.*) may not be mixed with other milk, or sold or used for human food in any way, nor may it be given without having been boiled to swine or other animals.

Sec. 17. Nothing in this order shall be deemed to interfere with the cattle sheds in Burghs (Scotland) Act, 1886.

Dairy, Cowsheds, and Milkshops Amending Order, 1886.

Art. 3. Imposes for violation of Order of 1885 a fine of £5, with D.P. of £2, either of which may be reduced by the Court; substitutes L.G.B. for P.C., and defines L.A.s.

CONTAGIOUS DISEASES (ANIMALS) ACT, 1878.

Sec. 34 (not repealed by D.A.A. 1894) P.C. [now B.A.] may make, subject to provisions of the Act, general or special orders for (1) registration by L.A. of persons carrying on the trades of cow-keepers, dairymen, or sellers of milk, (2) for inspection of cattle in dairies, and for the lighting, ventilation, cleansing, drainage, and water supply of dairies and cowsheds, occupied by persons so trading, (3) for the cleanliness of milk stores, shops, and vessels, (4) for protecting milk against contamination or infection, (5) authorizing L.A.s to make like regulations subject to conditions prescribed by P.C. [B.A.]. Dairies and cowsheds owned and occupied by persons not in the trade are exempt.

MODEL BYE-LAWS OF LOCAL GOVERNMENT BOARD.

These, which deal with every subject on which the S.A. may or shall make regulations, may be adopted as they stand, or be used by the S.A. for their guidance in drawing up bye-laws adapted to the special circumstances of the district. They treat of—

I. Clearing footways, privies, cesspools, &c., and removal of house refuse.
II. Prevention of nuisances.
III. Common lodging-houses.
IV. New streets and buildings.
V. Markets.
VI. Slaughter houses.
VII. Hackney carriages.
VIII. Public bathing.
IX. Baths and wash-houses, &c.
X. Pleasure grounds.
XI. Horses, &c., standing for hire.
XII. Pleasure-boats and vessels.
XIII. Houses let in lodgings.
XIV. Cemeteries.
XV. Mortuaries.
XVI. Offensive trades.

Those relating to offensive trades were issued in July 1882 (No. 14), and apply to the trades of blood-boiler, blood-dryer, bone-boiler, fellmonger, tanner, leather-dresser, soap-boiler, tallow-melter, fat-melter or fat-extractor, tripe-boiler, glue-maker, size-maker, and gut-scraper.

Much useful legal information is prefixed.

BYE-LAWS OF LONDON COUNTY COUNCIL.

(1) For regulating dimensions, form and mode of construction, and the keeping, cleansing and repairing of the pipes, drains and other means of communicating with sewers, and the traps and apparatus connected therewith. (M.M.A. 1855, sec. 202.)

(2) With respect to water-closets, earth-closets, privies, ash-pits, cesspools and receptacles for dung, in connection with buildings, whether constructed before or after the passing of the Act. (P.H.(L.)A. 1891, sec. 39, subs. 1.)

(3) For prescribing the times for the removal or carriage by road or water of any fæcal or offensive or noxious matter or liquid in or through London, and providing that the carriage or vessel used therefor shall be so constructed as to prevent the escape of any such matter or liquid, and as to prevent any nuisance arising therefrom. (P.H.(L.)A. sec. 16, subs. 2.)

(4) For the regulation of the following offensive trades, viz. slaughterer of cattle, knacker, gut scraper, fat melter or fat extractor, animal charcoal manufacturer, blood boiler, bone boiler, manure manufacturer, tallow melter, soap boiler, blood drier, catgut maker, and tripe boiler.

REPAYMENT OF PUBLIC LOANS.

Large sums of money are every year advanced to Local Boards and other public bodies, for improvements, building of workhouses, schools, harbours, bridges, &c., to be repaid in a given number of years, including interest. The following table for the repayments of loans gives the sums needed as the annual amount of principal combined with interest required for the liquidation of a debt of £100, at the stated percentage, in 10, 20, 30, 40, and 50 years:—

Years.	3 per Ct.			3½ per Ct.			4 per Ct.			4½ per Ct.			5 per Ct.		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
10	11	14	5½	12	0	5¾	12	6	7	12	12	9	12	19	0
20	6	14	5¼	7	0	8¾	7	7	2	7	13	9	8	0	5¾
30	5	2	0½	5	8	9	5	15	8	6	2	9½	6	10	1¼
40	4	6	6¼	4	13	7¾	5	1	0½	5	9	8¼	5	16	6¾
50	3	17	8¾	4	5	3¼	4	13	1¼	5	1	2½	5	9	6¾

APPENDIX A.

FORMS OF ORDERS, SUMMONSES, ETC.

contained in Sch. IV. of the P.H.A. 1875, and Sch. III. of the P.H.(L.)A. 1891, and in the H.W.C.A. 1890, Sch. IV.

A.—Order for Abatement of Nuisance.

To [*person causing nuisance, occupier or owner*], Take notice, that under the provisions of the $\left\{\begin{array}{l}\text{P.H.A. 1875}\\ \text{P.H.(L.)A. 1891}\end{array}\right\}$ the [*name L.A.*] being satisfied

of the existence at [*describe place*] of a nuisance being or arising from [*describe nature of nuisance*]	that at [*describe place*] there existed recently, to wit, on or about the day of the following nuisance, namely, [*describe nuisance*], and that although the said nuisance has since the last-mentioned day been abated, the same is likely to recur at the said premises,[1]
do hereby require you from the service of this notice to abate the same, and for that purpose to [*state things or works to be done*]	within [*specify time*] to do what is necessary for preventing the recurrence of the nuisance [and for that purpose, &c.]
If you make default in complying with the requisitions of this notice	If the said nuisance, though abated, is likely to recur

a summons will be issued requiring your attendance to answer a complaint which will be made to a $\left\{\begin{array}{l}\text{C.S.J. ('75)}\\ \text{P.S.C. ('91)}\end{array}\right\}$ for the purpose of enforcing the abatement of the nuisance, or prohibiting the recurrence thereof or both, and for recovering the costs and penalties that may be incurred thereby.

Dated this day of

[*Signature of officer of S.A.*]

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[1] This form for a prevention order is peculiar to the P.H.(L.)A.

B.—FORM OF SUMMONS.

To the occupier [*or* owner] of [*describe the premises*], *or* To A. B. of, &c.

County [*or* Borough] of to wit } You are required to appear before [*describe* {C.S.J. P.S.C.}] at the court [*or* petty sessions], holden on the day of next, at the hour of in the noon, to answer the complaint this day made to me by ,

that at or in the premises above-mentioned [*or* in or on certain premises situated at in the Street, in the parish of [*or other sufficient description of the premises*], in the district of [*describe the S.A.*], the following nuisance exists [*describe it*], and that the said nuisance is caused by the act or default of the occupier [*or* owner, *or if the person causing the nuisance be summoned*, by you, A.B.]

that there existed recently, to wit, on or about the day of , the following nuisance [*describe it*], and that the said nuisance was caused by the act or default of the occupier [*or* owner, *or* by you, A.B.], and although the same has since the said last-mentioned day been abated or discontinued, there is reasonable ground to consider that the same or the like nuisance is likely to recur at the said premises.

Given under my hand and seal this day of

J.S. (L.S.)

N.B.—In the forms appended to the P.H.(L.)A., the words "and that the said nuisance is [*or* was] caused by the act or default of the occupier [*or* owner]," and "there is reasonable ground to consider" are omitted; and where the person causing the nuisance is summoned, the words are, "and that the said nuisance is [*or* was] caused by the act, default, or sufferance of you, A.B."

C.—FORM OF ORDER FOR ABATEMENT OR PROHIBITION (*including Closing House U.H.H.*), P.H.A. 1875.

To the occupier [*or* owner] of [*describe premises*], *or* To A.B. of [*give his address*].

County [*or* Borough] of to wit } Whereas on the day of complaint was made before C.D., Esq., one of H.M.'s J.P.s acting, in and for the county [*or* Borough] of stated in the margin, by that in or on certain premises situated at in the district under the P.H.A. 1875, of [*name L.A.*] the following nuisance [*describe it*] then existed, and that the said nuisance was caused by the act or default of the owner [*or* occupier] of the said premises [*or by* A.B.]

And whereas the owner [*or* occupier] within the meaning of the said P.H.A. 1875 [*or* the said A.B.] hath this day appeared before us [*or* me, *describing the Court*]

existed on or about the day of [when it was *ascertained to exist*], and that the said nuisance was caused by the act, &c.; and although the same is now removed, the same or the like nuisance is likely to recur on the same premises. And whereas it hath been this day proved to our [*or* my] satisfaction, that a true copy of a summons requiring the owner [*or* occupier] of the said premises [*or* the said A.B.] to appear before us [*or* me] hath been duly served according to the said Act

Now on proof here had before us [*or* me] that the nuisance so complained of doth exist on the said premises, and that the same is caused by the act or default of the owner [*or* occupier] of the said premises [*or* by the said A.B.], we [*or* I], in pursuance of the said Act, do order the said owner [*or* occupier *or* A.B.] within [*name time*] from the service of this order, or a true copy thereof, according to the said Act [*here specify anything required to be done*], so that the same shall no longer be a nuisance or injurious to health as aforesaid.

(*If it appear to the Court that the nuisance is likely to recur on the same premises*) and we [*or* I] being satisfied that, notwithstanding the said cause or causes of nuisance may be removed under this order, the same is or are likely to recur, do therefore prohibit the said owner [*or* occupier *or* A.B.] from [*here state matter of prohibition*], e.g. using the said house for human habitation until the same in our [*or* my] judgment is rendered fit for that purpose [*or any other work as the case may require is done*].

(*In case the nuisance were removed before complaint but is likely to recur.*) Now on proof here had before us [*or* me] that at or recently before the making of the said complaint, to wit on as aforesaid, the cause of nuisance complained of did exist on the said premises, but that the same hath since been removed; yet notwithstanding such removal, we [*or* I] being satisfied that it is likely that the same or the like nuisance will recur on the said premises, do hereby prohibit [*order of prohibition*], and if this order of prohibition be infringed then we [*or* I] [*here state the order on L.A. to do the works*]

Given under the hands and seals of us [*or* the hand and seal of the (*here describe the Court*)] this day of

L.S. (L.S.)
J.P. (L.S.)

D.—(P.H.A. 1875). FORM OF ORDER FOR ABATEMENT OF NUISANCE BY THE L.A.

To the Town Council [&c., *as the case may be*].

County, &c. ⎫ Whereas [*recite complaint of nuisance as in* of......to Wit. ⎭ *Form C.*] and whereas it hath been now proved to our [*or* my] satisfaction that such nuisance exists, but that no owner or occupier of the premises [*or* person causing the nuisance, *as the case may be*], can be found. Now we [*or* I] in pursuance of the said Act do order the said [*name L.A.*] forthwith to [*specify works to be executed*].

Given, &c., *as in Form C.*

E.—(P.H.A. 1875). FORM OF ORDER TO PERMIT EXECUTION OF WORKS BY OWNER.

County, &c. ⎫ Whereas complaint hath been made to me of......to Wit. ⎭ E. F., Esq., one of H.M.'s J.P.s in and for the County, &c., of.........by A.B., owner within the meaning of the P.H.A. 1875, of certain premises [*describe them*] that C.D. the occupier of the said premises doth prevent the said A.B. from obeying and carrying into effect the provisions of the said Act, in this, to wit, that the said C.D. doth prevent the said A.B. from [*here describe generally the works required by previous order to be done*].

And whereas the said C.D., having been duly summoned to answer the said complaint, and not having shown sufficient cause against the same; and it appearing to me that the said works are necessary for the purpose of enabling the said A.B. to obey and carry into effect the provisions of the said Act, I do hereby order that the said C.D. do permit the said A.B. to execute the same in the manner prescribed by the said Act.

Given under my hand and seal this..............day of.........

J.S. (L.S.)

F.—(P.H.A. 1875). ORDER OF JUSTICE FOR ADMISSION OF OFFICER OF L.A.

Whereas [*describe L.A.*] have by their officer [*name him*] made application to me A.B., one of H.M.'s J.P.s having jurisdiction in and for [*describe the place*], and the said officer has made oath to me that demand has been made pursuant to the provisions of the P.H.A. 1875 for admission to [*describe the premises sufficiently*] for the purpose of [*describe it*] and that such demand has been refused.

Now therefore I, the said A.B., do hereby require you [*name the person having custody of the premises*] to admit the said [*name L.A.*] [*or* the officer of the said L.A.] to the said premises for the purpose aforesaid.

Given, &c., (*as in last form*).

G.—(P.H.(L.)A. 1891). FORM OF NUISANCE ORDER.

To A.B. of............[*or* to the owner, or occupier of] [*describe premises*] situated [*give description sufficient for identification.*]

County of ......to Wit. } Whereas the said A.B. [*or* the owner *or* occupier of the said premises within the meaning of the P.H.(L.)A. 1891] has this day appeared before me [*or* us, *describe Court*]

County of ......to Wit. } Whereas it has now been proved to my [*or* our] satisfaction that a summons has been duly served according to the P.H.(L.)A. 1891, requiring the said A.B. [*or* the owner *or* the occupier of the said premises] to appear this day before me [*or* us] &c.

to answer the matter of a complaint made by, &c., that at, &c., [*follow the words of complaint in summons*].

Abatement Order.

Now on proof here had before me [*or* us] that the nuisance so complained of does exist at the said premises [*add where the order is made on the person causing the nuisance*, and that the same is caused by the act, default, or sufferance of A.B.] I [*or* we] in pursuance of the P.H.(L.)A. 1891, do order the said A.B. [*or* the owner *or* occupier] within [*specify the time*] from the service of this order according to the said Act [*here specify the nuisance to be abated*] *e.g.* to prevent the &c., &c., being a nuisance or dangerous or injurious to health and to [*here state any works to be executed*].

Prohibition Order. (1).

And I [*or* we] being satisfied that notwithstanding the said nuisance may be temporarily abated under this order, the same is like to recur, do therefore prohibit the said A.B. [*or* the said owner *or* occupier] from allowing the recurrence of the said or a like nuisance, and for that purpose I [*or* we] direct the said A. B. [*or* owner *or* occupier] to [*here specify any works to be executed*].

Prohibition Order. (2).

Now on proof here had before me [*or* us] that at or recently before the time of making the said complaint, to wit on .... the nuisance so complained of did exist at the said premises but that the same has been abated [*add when order is made on the person causing the nuisance*, and that the nuisance was caused by the act, default, or sufferance of A.B.] yet notwithstanding such abatement I [*or* we] being satisfied that it is likely that the same or the like nuisance will recur at the said premises, do therefore prohibit [*continue as in prohibition order* (1)].

Closing Order.

Now on proof here had before me [*or* us] that the nuisance is such as to render the dwelling-house [*describe the house*] situated at [*sufficient description*] unfit in my [*or* our] judgment for human habitation I [*or* we] in pursuance of the P. H. (L.) A. do hereby prohibit the use of the said dwelling-house for human habitation.

Given under the hand and seal of me [*or* the hands and seals of us] [*describing the Court*]

This.........day of.........

J.S. (L.S.)
J.P. (L.S.)

H.—(P.H.(L.)A. 1891). FORM OF NUISANCE ORDER TO BE EXECUTED BY S.A.

To the [*describe S.A.*]

County of } ......to Wit. } Whereas a complaint has been made by.................. that at certain premises situated at No......in...... street in the parish of.........[*or other sufficient description*] the following nuisance exists [*describe nuisance*], and it has been now proved to my [*or* our] satisfaction that such nuisance exists, but that no owner or occupier of the premises or person by whose act, default, or sufferance the nuisance is caused, is known *or* can be found [*as the case may be*]. Now I [*or* we] in pursuance of the P.H.(L.)A. 1891, do [*continue as in any of the orders in Form C., substituting name of S.A. for that of A.B. &c*].

Given, &c., [*as in last form*].

I.—(P.H.(L.)A. 1891). WARRANT OF JUSTICE FOR ENTRY TO PREMISES.

Whereas A.B., being a person authorized under the P.H.(L.)A. 1891, to enter certain premises [*describe them*] has made application to me C.D. one of H.M.'s J.P.s having jurisdiction in and for [*name place*] to authorize the said A.B. to enter the said premises, and whereas I, C.D., am satisfied by information on oath that there is reasonable

ground for such entry, and that there has been a refusal or failure to admit to such premises, and [*either*] that reasonable notice of the intention to apply to a justice for a warrant has been given, [*or*] that the giving of notice of the intention to apply to a justice for a warrant, would defeat the object of the entry,

cause to believe that there is on the same premises a contravention of the P.H.(L.)A. 1891, or of a bye-law under that Act, and that an application for admission, or notice of an application for a warrant, would defeat the object of the entry,

Now therefore I, the said C.D. do hereby authorize A.B. to enter the said premises, and if need be by force, with such assistants as he may require, and there execute his duties under the said Act.

Given, &c., [*as in last form*].

K.—(H.W.C.A. 1890). FORM OF NOTICE REQUIRING PREMISES TO BE MADE FIT FOR HUMAN HABITATION.

To [*person causing premises to be U.H.H. or the O. or O., as the case may be*].

Take notice that under the provisions of the P.H.A. 1875 [*or* the P.H.(L.)A. 1891], and the H.W.C.A. 1890, the [*describe L.A.*] being satisfied that the following premises, that is to say [*describe premises*], are in a state so dangerous as to be dangerous or injurious to health, or to be *U.H.H.*, do hereby require you within.........from the service of this notice to make the said premises fit for *H.H.*

If you make default in complying with the requisitions of this notice, proceedings will be taken before a C.S.J. for prohibiting the use of the premises for *H.H.*

Dated this.........day of.........

[*Sig. of Officer of L.A.*]

L.—(H.W.C.A. 1890). FORM OF SUMMONS FOR CLOSING ORDER.

To the owner or occupier of [*describe premises*] situate at [*sufficient description of place*].

County of [*or* Borough *or* District, *as the case may be.*] } You are required to appear before [*describe C.S.J.*] at the petty sessions [*or* Court] holden at.........on the......day of.........next, at the hour of......in the......noon, to answer the complaint this day made to me by.........that the premises above-mentioned are used as a dwelling-place and are in a state so dangerous or injurious to health as to be *U.H.H.*

Given under my hand and seal this.........day of.........18......

M.—(H.W.C.A. 1890). FORM OF CLOSING ORDER.

To the owner [*or occupier*] of [*describe premises*] situated at [*sufficient description*].

County of [*or* Borough *or* District, *as the case may be.*] } Whereas, on the.........day of.........complaint was made before.........Esq., one of H.M.'s J.P.'s acting in and for the County [*or* Borough, &c.] stated in the margin, viz.........that certain premises situated at.........in the district under the P.H.A. 1875 [*or like Act*] of [*name L.A.*] were in a state so dangerous or injurious to health as to be *U.H.H.*

And whereas......the owner [*or* occupier] within the meaning	And whereas it hath this day been proved to our [*or* my]

of the said P.H.A., 1875, hath this day appeared before us [*or* me] to answer the matter of the said complaint.

satisfaction that a true copy of a summons requiring the owner [*or* occupier] of the said premises [*or* the said A.B.] to appear this day before us [*or* me]......hath been duly served according to the said Act and the H.W.C.A. 1890.

Now on proof here had before us [*or* me] that the said premises are in a state so dangerous or injurious to health as to be *U.H.H.*, we [*or* I] in pursuance of the said Acts do prohibit the using of the premises for the purpose of *H.H.* until in our [*or* my] judgment they are rendered fit for that purpose.

Given under the hand and seal of &c., &c.

DEFINITIONS OF UNFITNESS FOR HUMAN HABITATION.

1. A house may be considered "so dangerous or injurious to health" as to be permanently unfit for human habitation, which—

(*a*) By reason of age or decay has become so dilapidated or worn out, as to be practically incapable of repair, or—

(*b*) Having been originally constructed of bad or improper materials, is offensive and unwholesome, or is—

(*c*) Incapable of being sufficiently drained, or—

(*d*) Has been erected upon an improper foundation, or without proper damp course, so that it is impregnated with foul air, or is incurably damp, or—

(*e*) Is without, and incapable of being provided with proper lighting, and through ventilation.

2. A house may be considered to be temporarily unfit for "human habitation," which is in "such a state as to be a nuisance or injurious to health," whether—

(*a*) From dilapidations so as not to be protective of its inmates, or—

(*b*) From want of light and ventilation, or—

(*c*) From dampness of a temporary character, or—

(*d*) From defective drainage arrangements, leading to incursions of sewer-air, or—

(*e*) From a defective or ill-placed water-closet incapable of being lighted and ventilated from the outside, or—

(*f*) From the want of a wholesome water supply due to whatever cause, or—

(*g*) From the want of a separate water supply for the service of each water-closet, or—

(*h*) From general dirtiness.

APPENDIX B. TABLE A.—*Table of Deaths during the year* .... *in the*......................... *of*..........................

classified according to Diseases, Ages, and Localities.

(1)	MORTALITY FROM ALL CAUSES AT SUBJOINED AGES.							(2)	MORTALITY FROM SUBJOINED CAUSES, DISTINGUISHING DEATHS OF CHILDREN UNDER FIVE YEARS OF AGE.																
NAMES OF LOCALITIES ADOPTED.	At all ages.	Under 1 year.	1 and under 5.	5 and under 15.	15 and under 25.	25 and under 60.	60 and upwards.		Scarlatina.	Diphtheria.	Membranous Croup.*	Enteric or Typhoid Fever.	Puerperal Fever.	Influenza.	Measles.	Whooping Cough.	Diarrhoea and Dysentery.	Rheumatic Fever.	Ague.†	Phthisis.	Bronchitis, Pneumonia, and Pleurisy.	Heart Disease.	Injuries.	All other Diseases.	TOTAL.
(a)								Under 5.																	
								5 upwds.																	
(b)								Under 5.																	
								5 upwds.																	
TOTALS ...																									
Of the subjoined numbers those relating to (3) are included, but those relating to (4) are excluded in judging of the above records of mortality.																									
(3) Deaths occurring outside the division or district among persons belonging thereto ...								Uuder 5.																	
								5 upwds.																	
(4) Deaths occurring within the division or district among persons not belonging thereto								Under 5.																	
								5 upwds.																	

[* Fatal Croup should be returned with Diphtheria, there being no possible advantage in attempts at distiuguishing them, and the column would be well left for occasional epidemics, or outbreaks of small-pox, typhus, cholera, or plague.—E. F. W.]

[† A very rare "cause of death." This column would be far better given to Cancer.—E. F. W.]

TABLE B.—*Showing the Causes of Death in* ....
during each of the four quarters of the year ....

CAUSES OF DEATH.	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	TOTALS.
Scarlet Fever					
Diphtheria					
*Membranous Croup					
Typhoid Fever					
Puerperal Fever					
Measles					
Whooping Cough					
Diarrhœa and Dysentery ...					
Rheumatic Fever					
*Ague					
Influenza					
Phthisis (Consumption) ...					
Other Tubercular Diseases...					
Diseases of Respiratory Organs other than Phthisis					
Diseases of Circulatory Organs					
Diseases of Digestive Organs					
Diseases of Reproductive Organs					
Diseases of Nervous System (including Apoplexy and Convulsions)					
Cancer					
Rheumatism					
Premature Birth					
Senility					
Wasting and Debility and Developmental Defects ...					
Accidents (including Overlying)					
Suicides					
Pyæmia and Septicæmia (Blood-poisoning)... ...					
Syphilis					
†Plumbism					
TOTALS					

[* See under Table A.]

[† Any other locally prevalent industrial disease, as phosphorus, or arsenical, or mercurial poisoning contracted in trade work should be entered here.—E. F. W.]

TABLE C.—*Table of Population, Births, and of New Cases of Infectious Sickness, coming to the knowledge of the Medical Officer of Health, during the year .... in the .... of .... classified according to Diseases, Ages, and Localities.*

NAMES OF LOCALITIES (Wards or others).	Population at all Ages.		Registered Births.	Age under 5 or over 5.	New cases of Sickness in each locality, coming to the knowledge of the Medical Officer of Health.								Number of such cases removed from their homes in the several localities for treatment in Isolation Hospitals.					
	Census 1891.	Estimated to middle of 1895.			Small-pox.	Scarlatina.	Diphtheria.	Membranous Croup.*	FEVERS.		Erysipelas.	TOTALS.	Small-pox.	Scarlatina.	Diphtheria.	FEVERS.	Erysipelas.	TOTALS.
									Enteric or Typhoid.	Puerperal.						Enteric or Typhoid.		
(a)				Under 5.														
				5 upwards.														
(b)				Under 5.														
				5 upwards.														
...																		
TOTALS ...																		

TABLE D.—*The Causes of Infantile Mortality.*

	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	TOTAL.
Premature Birth and Insufficient Vitality ...					
Diarrhœa					
Wasting and Debility					
Diseases of Lungs					
Gastric Catarrh and Enteritis					
Tuberculosis					
Measles					
Scarlet Fever					
Diphtheria, &c.					
Whooping Cough					
Convulsions					
Overlying					
Other causes					
TOTALS					

Tables A and B are forms prescribed by the Local Government Board to be annexed to his Annual Report by the M.O.H.

Table C is required in places where the Notification of Infectious Diseases is in force.

Table D is not of statutory obligation, but is one of several recommended by the Society of M.O.H., and is calculated to assist in elucidating the special causes of infant mortality in a district.

Table E is of the same class.

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* See note *in loco* under Table A.

TABLE E.

DIVISION I. All ages.	Total Deaths.	Deaths per 1000, at all ages.	Deaths per 1000, total at all ages.
1. Principal zymotic diseases ... ... 2. Pulmonary diseases 3. Principal tubercular diseases			
DIVISION II. **Infants under one year.**	**Total Deaths.**	**Deaths per 1000 Births.**	**Deaths per 1000, total deaths under one year.**
4. Wasting diseases ... 5. Convulsive diseases			

The M.O.H. should enumerate the diseases that he includes under these heads; but the classification not being of statutory obligation he may adopt any grouping he thinks fit; thus though the Society of M.O.H. placed rickets under No. 3, it should certainly be referred to No. 4.—E. F. W.

APPENDIX C.

DUTIES OF INSPECTORS OF NUISANCES, AND SYLLABUS OF SUBJECTS FOR EXAMINATION.

Duties of Inspectors of Nuisances as defined by the order of the Local Government Board, March 1891.	*Syllabus of Subjects for Examination of the Sanitary Institute.*
(1) He shall perform, either under the special directions of the Sanitary Authority, or so far as authorized by the Sanitary Authority, under the directions of the Medical Officer of Health, or in cases where no such directions are required, without such directions, all the duties specially imposed upon an Inspector of Nuisances by the Public Health Act, 1875, or by any other Statute or Statutes, or by the Orders of the Local Government Board, so far as the same apply to his office.	The Provisions of the Acts and Model By-Laws relating to the duties of Inspectors of Nuisances.
(2) He shall attend all meetings of the Sanitary Authority when so required. (3) He shall by inspection of the District, both systematically at certain periods, and at intervals as occasion may require, keep himself informed in respect of the nuisances existing therein that require abatement. (4) On receiving notice of the existence of any nuisances within the District, or of the breach of any by-laws or regulations made by the Sanitary Authority for the suppression of nuisances, he shall, as early as practicable, visit the spot, and inquire into such alleged nuisance or breach of by-laws or regulations. (5) He shall report to the Sanitary Authority any noxious, or offensive businesses, trades, or manufactories established within the District, and the breach or non-observance of any by-laws or regulations made in respect of the same.	A knowledge of what constitutes a Nuisance. Methods of Inspection, of Dwellings, Cellar Dwellings, Dairies, Milk-shops, Markets, Slaughter-houses, Cow-sheds, Canal Boats and Nuisances especially connected with Trades and Manufactories.

Duties of Inspectors of Nuisances (continued).	*Syllabus of Subjects (continued).*
(6) He shall report to the Sanitary Authority any damage done to any works of water supply, or other works belonging to them, and also any case of wilful or negligent waste of water supplied by them, or any fouling by gas, filth, or otherwise, of water used for domestic purposes.	The Physical Characteristics of good Drinking Water—the various ways in which it may be polluted, by Damage to Supply Works or in Houses, and the means of preventing pollution—Methods of Water Supply.
(7) He shall from time to time, and forthwith upon complaint, visit and inspect the shops and places kept or used for the preparation or sale of butchers' meat, poultry, fish, fruit, vegetables, corn, bread, flour, milk, or any other article to which the provisions of the Public Health Act, 1875, in this behalf shall apply, and examine any animal, carcase, meat, poultry, game, flesh, fish, fruit, vegetables, corn, bread, flour, milk, or any other article as aforesaid, which may be therein; and in case any such article appear to him to be intended for the food of man, and to be unfit for such food, he shall cause the same to be seized, and take such other proceedings as may be necessary in order to have the same dealt with by a Justice: Provided, that in any case of doubt arising under this clause, he shall report the matter to the Medical Officer of Health, with the view of obtaining his advice thereon.	The characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables).
(8) He shall, when and as directed by the Sanitary Authority, procure and submit samples of food, drink, or drugs suspected to be adulterated, to be analysed by the analyst appointed under "The Sale of Food and Drugs Act, 1875," and upon receiving a certificate stating that the articles of food, drink, or drugs are adulterated, cause a complaint to be made, and take the other proceedings prescribed by that Act.	The Sale of Food and Drugs' Act.

Duties of Inspectors of Nuisances (*continued*).	*Syllabus of Subjects* (*continued*).
(9) He shall give immediate notice to the Medical Officer of Health of the occurrence within the district of any contagious, infectious, or epidemic disease ; and whenever it appears to him that the intervention of such officer is necessary in consequence of the existence of any nuisance injurious to health, or of any overcrowding in a house, he shall forthwith inform the Medical Officer of Health thereof.	The Regulations affecting persons suffering or recovering from Infectious diseases, and some knowledge of such diseases—The principles of Ventilation, and simple methods of Ventilating Rooms—Measurement of Cubic Space.
(10) He shall, subject to the directions of the Sanitary Authority, attend to the instructions of the Medical Officer of Health with respect to any measures which can be lawfully taken by an Inspector of Nuisances under the Public Health Act, 1875, or under any other Statute or Statutes, for preventing the spread of any contagious, infectious, or epidemic disease of a dangerous character.	Disinfectants and Methods of Disinfection.
(11) He shall enter from day to day, in a book to be provided by the Sanitary Authority, particulars of his inspections and of the action taken by him in the execution of his duties. He shall also keep a book or books, to be provided by the Sanitary Authority, so arranged as to form, as far as possible, a continuous record of the sanitary condition of each of the premises in respect of which any action has been taken under the Public Health Act, 1875, or under any other Statute or Statutes, and shall keep any other systematic records that the Sanitary Authority may require. (12) He shall at all reasonable times, when applied to by the Medical Officer of Health, produce to him his books, or any of them, and render to him such information as he may be able to furnish with respect to any matter to which the duties of Inspector of Nuisances relate.	A Knowledge of the General Duties of the Office, and Methods of keeping the necessary Books and Records—Writing and Spelling.

Duties of Inspectors of Nuisances (continued).

(13) He shall, if directed by the Sanitary Authority to do so, superintend and see to the due execution of all works which may be undertaken under their direction for the suppression or removal of nuisances within the district.

(14) He shall, if directed by the Sanitary Authority to do so, act as Officer of the said Authority as Local Authority under the Contagious Diseases (Animals) Act, 1886, and any Orders or Regulations made thereunder.

(15) In matters not specially provided for in this Order, he shall observe and execute all the lawful orders and directions of the Sanitary Authority, and the Orders of the Local Government Board which may be hereafter issued, applicable to his office.

Syllabus of Subjects (continued).

The necessary conditions of good Drainage—The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builders' and Plumbers' work—Scavenging and the Disposal of Refuse.

APPENDIX D.

RULES RESPECTING DRAINAGE AND OTHER SANITARY ARRANGEMENTS TO BE OBSERVED BY BUILDERS.

1. All drains and soil-pipes shall, as far as possible, be kept outside the houses.

2. The underground drains shall be made of sound glazed stoneware pipes, with well-fitting joints made water-tight with Portland cement or other approved material. The main drains shall not be less than six inches in diameter.

3. They shall be laid evenly with a regular gradient from the sewer upon a bed of concrete or other suitable solid foundation.

4. They shall have no sharp curves; and especially any portion that may be situated under the house shall be laid, where practicable, in a direct line and without junctions.

5. The main drain shall, where desirable, be disconnected from the sewer by an approved Interceptor.

6. The drains shall, where practicable, be ventilated by a fresh-air inlet placed in the main drain as near as possible to the Interceptor, and by outlet shafts of not less than three inches in diameter, prolonged directly upwards from the soil pipes outside the house, to the highest point of the roof, or at least three feet above the top of the highest window.

7. An inspection-chamber shall, where practicable, be provided between the Interceptor and the fresh-air inlet.

8. Rain-water pipes, sink pipes, and waste-water pipes of all kinds shall discharge outside the house into a stoneware siphon gully communicating directly with the underground drain.

9. All sink pipes, as also soil pipes, shall, as far as practicable, have no sharp curves.

10. Proper Y junctions shall, in all cases, be made in connection with all underground drains. No right-angle junction shall be allowed.

11. Water-closets, if not outside the house, shall, where practicable, be placed against an external wall, and be properly ventilated by windows communicating directly with the external air.

12. Cisterns for drinking water shall be of sufficient size, made of slate, or zinc, or galvanized iron, well covered, and so placed as to allow of easy cleansing, and not be exposed to risk of contamination.

13. If a cistern be used in common for drinking purposes and for flushing a water-closet, it shall be provided with a waste preventer of approved pattern.

14. There shall be an open air space of at least six inches between the lowest floor joists of all newly-erected buildings and the surface of the subsoil, and this space shall be properly ventilated by means of air-bricks suitably placed.

15. There shall be an approved damp-proof course above the ground or basement level.

16. Staircases and passages, especially those of tenement houses, shall be well lighted and ventilated by direct communication with the external air.

Notice of the intention to build new or alter existing premises, with a plan of the same (forms to be procured at the Office of the Local Authority), shall be deposited with their surveyor, showing the proposed drainage works, and no part of such drainage shall be laid until the plan has been approved by him, nor shall any portion thereof be covered up or filled in until it has been inspected and passed by the surveyor or sanitary inspector of the district.

It is recommended—

1. That the use of pan-closets with containers and also those of the long hopper class be discontinued.*

2. That for surface-traps stoneware siphon gullies only be used.

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* In Brighton it is a bye-law that no such closet shall be fixed, or existing one repaired in the future, and the whole of these rules and recommendations have been incorporated into the new bye-laws of the London County Council.

APPENDIX E.—THE CENSUS OF 1901. I. ENGLAND AND WALES.

POPULATION ENUMERATED IN 1891 AND 1901.

	Population.	
	1891.	1901.
ENGLAND AND WALES... ...	29,002,525	32,525,716
62 Administrative Counties	20,935,597	23,386,526
67 County Boroughs	8,066,928	9,139,190
ADMINISTRATIVE COUNTIES.		
ENGLAND—		
Bedfordshire	161,378	171,699
Berkshire	176,119	180,366
Buckinghamshire	186,680	196,843
Cambridgeshire	120,645	120,634
Isle of Ely	63,340	64,494
Chester	535,944	601,042
Cornwall	322,571	322,857
Cumberland	266,549	266,904
Derbyshire	425,472	504,577
Devonshire	442,287	436,913
Dorset	193,542	202,093
Durham	720,793	833,310
Essex	578,471	816,524
Gloucestershire	323,980	331,515
Herefordshire	115,762	114,150
Hertfordshire	226,587	258,044
Huntingdonshire	55,015	54,127
Kent	807,328	936,003
Lancaster	1,564,696	1,827,330
Leicestershire	201,639	225,895
Lincolnshire—Holland	76,204	77,583
,, Kesteven	105,361	103,957
,, Lindsey	199,051	206,497
London	4,228,317	4,536,034
Middlesex	542,894	792,225
Monmouthshire	203,426	230,792
Norfolk	318,301	313,438
Northamptonshire	189,218	207,466
Soke of Peterborough	35,249	41,119
ENGLAND—*continued.*		
Northumberland	319,730	387,728
Nottinghamshire	231,745	274,683
Oxfordshire	143,753	137,118
Rutlandshire	20,659	19,708
Shropshire	236,827	239,297
Somerset	378,166	385,059
Southampton	334,194	377,121
Isle of Wight	78,672	82,387
Staffordshire	771,258	879,625
Suffolk—Eastern	183,405	189,153
,, Western	121,350	117,535
Surrey	419,115	519,522
Sussex—Eastern	227,699	261,691
,, Western	140,987	151,540
Warwickshire	301,412	347,693
Westmoreland	66,215	64,411
Wiltshire	262,551	271,372
Worcestershire	297,389	358,357
Yorkshire—East Riding	141,180	145,877
,, North Riding	284,015	285,681
,, West Riding	1,294,423	1,460,857
WALES—		
Anglesey	50,098	50,475
Brecknock	51,393	54,211
Cardigan	63,467	61,068
Carmarthen	130,566	135,320
Carnarvon	117,586	125,654
Denbigh	118,979	131,588
Flint	77,041	81,487
Glamorgan	467,954	601,080
Merioneth	48,859	48,786
Montgomery	58,003	54,892
Pembroke	88,296	87,856
Radnor	21,791	23,263

POPULATION ENUMERATED IN 1891 AND 1901 IN COUNTY BOROUGHS.

County Boroughs.	Population.		County Boroughs.	Population.	
	1891.	1901.		1891.	1901.
Barrow-in-Furness	51,712	57,589	Leicester	174,624	211,574
Bath	51,844	49,817	Lincoln	41,491	48,783
Birkenhead ...	99,857	110,906	Liverpool	629,548	685,276
Birmingham ...	478,113	522,182	Manchester ...	505,368	543,930
Blackburn	120,064	127,527	Middlesbrough ...	75,532	91,300
Bolton	146,487	168,205	Newcastle-on-Tyne	186,300	214,881
Bootle	49,217	57,913	Newport (Monmth.)	54,707	61,474
Bournemouth ...	37,785	47,003	Northampton ...	75,075	87,021
Bradford	265,728	279,809	Norwich	100,970	111,728
Brighton	115,873	123,478	Nottingham ...	213,877	239,753
Bristol	289,280	328,836	Oldham	131,463	137,238
Burnley	87,016	97,044	Oxford	45,742	49,413
Burton-on-Trent ...	46,047	50,386	Plymouth	88,926	107,509
Bury	57,212	58,028	Portsmouth ...	159,278	189,160
Canterbury	23,062	24,401	Preston	107,573	120,860
Cardiff	128,915	163,844	Reading	60,054	72,214
Chester	37,105	36,281	Rochdale	76,161	83,112
Coventry	58,503	69,877	St. Helens	72,413	84,410
Croydon	102,695	133,885	Salford	198,139	221,015
Derby	94,146	105,785	Sheffield	324,243	380,717
Devonport	55,981	69,674	Southampton ...	82,126	103,500
Dudley	45,724	48,809	South Shields ...	78,391	97,272
Exeter	45,588	47,180	Stockport	70,263	78,871
Gateshead	85,692	109,891	Sunderland	131,686	146,828
Gloucester	41,303	47,944	Swansea	90,349	94,505
Great Yarmouth ...	49,334	51,250	Walsall	71,789	86,440
Grimsby	51,934	63,119	Warrington	55,288	64,241
Halifax	97,714	104,997	West Bromwich ...	59,538	65,172
Hanley	54,946	61,519	West Ham	204,903	267,308
Hastings	63,072	65,528	Wigan	55,013	60,770
Huddersfield ...	95,420	95,008	Wolverhampton ...	82,662	94,179
Ipswich	57,433	66,622	Worcester	42,908	46,620
Kingston-on-Hull ...	200,472	238,562	York	67,749	77,790
Leeds	367,505	428,953			

POPULATION IN 1891 AND 1901 IN THE CITY OF LONDON AND THE METROPOLITAN BOROUGHS WITHIN THE COUNTY OF LONDON.

Metropolitan Boroughs.	Population.		Metropolitan Boroughs.	Population.	
	1891.	1901.		1891.	1901.
City of London ...	37,705	26,908	Lambeth	278,393	301,873
Battersea	150,166	168,896	Lewisham	88,933	127,460
Bermondsey ...	136,014	130,486	Paddington ...	135,955	143,954
Bethnal-green ...	128,929	129,681	Poplar	166,880	168,838
Camberwell ...	233,706	259,258	St. Marylebone ...	144,083	133,329
Chelsea	72,954	73,856	St. Pancras ...	234,749	235,284
Deptford	101,749	110,513	Shoreditch	124,727	118,705
Finsbury	109,981	101,476	Southwark	202,479	206,128
Fulham	91,790	137,289	Stepney	285,116	298,548
Greenwich	78,514	95,757	Stoke Newington ...	47,988	51,247
Hackney	199,606	219,288	Wandsworth ...	155,524	232,030
Hammersmith ...	97,283	112,245	Westminster, City of	201,969	182,977
Hampstead ...	68,126	81,902	Woolwich	98,994	117,165
Holborn	66,778	59,390			
Islington	319,155	334,928	Administrative County of London ...	4,228,317	4,536,034
Kensington ...	170,071	176,623			

The total population is made up as follows—

County of London	4,536,034
Other administrative counties	18,850,492
County boroughs	9,139,190
Total	32,525,716

The increase per cent., therefore, over the whole of England and Wales since 1891 has been greater by one-half per cent. than during the previous decennium.

Population, March 31, 1901	32,525,716
,, April 6, 1891	29,002,525
,, April 4, 1881	25,974,439
Increase from 1891 to 1901	3,523,191
,, ,, 1881 to 1891	3,028,086
Increase per cent. during intercensal period 1891 to 1901	12·15
Increase per cent. during intercensal period 1881 to 1891	11·65

This may also be illustrated by the following comparison—

Ascertained population on March 31, 1901	32,525,716
Population as estimated by the Registrar-General on the same day on the basis of increase in the previous decade ...	32,356,731
Excess	168,985

LONDON AND THE OUTER RING.

The following table shows the population of Inner and Outer London and the totals for Greater London, as brought out by the censuses of 1871, 1881, 1891, and 1901.

	1871.	1881.	1891.	1901 (Provisional).
Inner London ...	3,253,785	3,815,544	4,211,743	4,536,034
Outer Ring	631,856	951,117	1,422,063	2,042,750
Greater London ...	3,885,641	4,766,661	5,633,806	6,578,784

It may be noted that the area of Inner London was not quite the same in 1901 as in 1891, and that the population of the present area in 1891 was 4,228,317. The rate of increase in population both of Inner and Outer London was not so high in the period 1891–1901 as during the previous ten years, and as regards Inner London was much lower than in the periods 1871–81 and 1861–71. The rate of increase of the Outer Ring was about 50 per cent. in each of the periods 1861–71, 1871–81, and 1881–91, and fell to 43·6 per cent. for 1891–1901. This Outer Ring is the area covered by that part of the Metropolitan Police District which is outside the County of London.

ERRORS IN THE ESTIMATED POPULATIONS OF THE 33 GREAT TOWNS SHOWN BY THE CENSUS 1901.

Liverpool ...	−7·8	Manchester ...	+1·8	Leicester ...	+ 5·8
Wolverhampton	−4·2	Halifax ...	+1·8	Preston ...	+ 6·1
Plymouth ...	−3·7	Leeds	+2·2	Birkenhead ...	+ 7·0
Sheffield ...	−2·7	Hull	+2·2	Huddersfield ...	+ 9·9
Bristol	+0·1	Gateshead ...	+2·2	Newcastle ...	+10·5
Birmingham ...	+0·4	London ..	+2·5	Oldham ...	+11·9
Croydon ...	+0·6	Nottingham ...	+2·6	Swansea ...	+11·9
Salford	+1·1	Derby	+3·5	Blackburn ...	+15·5
Bolton	+1·2	Norwich ...	+4·1	Cardiff	+18·8
Brighton ...	+1·3	Bradford ...	+5·0	West Ham ...	+18·9
Sunderland ...	+1·6	Portsmouth ...	+5·1	Burnley ...	+19·5

Errors not exceeding + or − 5% may be deemed unavoidable, and might occur in a quinquennial census; but in eight of the 33 towns the population has been over-estimated by 10% or more, and in three of these by nearly 20%, completely falsifying the death-rates—*e.g.*, Burnley's assumed death-rate of 19·6 proving to be no less than 22·8.

The case of Liverpool is specially instructive. Over-estimated in 1891, when commercial depression had checked the stream of immigration and turned the increase in the decennium 1871–81 of 12% into a decrease of 6·2% in the period 1881–91, it has now been under-estimated by 7·8% in consequence of a turn of the tide; but though the death-rate will be lowered by the correction, it remains to be seen whether there is any *natural increase* of the population, or whether the deaths still exceed the births.

The actual increase of a population over the natural increase is of course an indication of prosperity, but the apparent absence of any considerable accession of new inhabitants is often no conclusive evidence of stagnation or depression, nor is even a decrease in the enumerated population, for the whole of the municipal area may have been built over, and in parts dwellings may have been displaced by factories and warehouses, the real growth, under such conditions, necessarily taking the form of populous suburbs springing up in the surrounding districts, and showing itself in the increase of the population of the county, though the inhabitants of these suburbs are socially and industrially members of the same community as those within the boundaries, where large numbers of them pass their working hours. This has doubtless been the case with such towns as Manchester, Salford, Birmingham, and Bristol.

II.—SCOTLAND.

POPULATION IN 1901.

Counties.	Population.	Increase.	Decrease.
Aberdeen	303,889	19,853	—
Argyll	73,166	—	919
Ayr	254,133	27,747	—
Banff	61,439	—	245
Berwick	30,785	—	1,505
Bute	18,659	255	—
Caithness	33,619	—	3,558
Clackmannan	31,991	—	1,149
Dumbarton	113,660	15,646	—
Dumfries	72,562	317	—
Edinburgh	437,553	3,277	—
Elgin	44,757	1,286	—
Fife	218,350	27,985	—
Forfar	283,729	5,994	—
Haddington	38,653	1,276	—
Inverness	89,901	—	220
Kincardine	40,891	5,399	—
Kinross	6,980	307	—
Kirkcudbright	39,359	—	626
Lanark	1,337,848	231,949	—
Linlithgow	64,787	11,979	—
Nairn	9,291	136	—
Orkney	27,723	—	2,730
Peebles	15,066	316	—
Perth	123,255	1,070	—
Renfrew	268,418	37,606	—
Ross & Cromarty	76,149	—	2,578
Roxburgh	48,793	—	4,707
Selkirk	23,339	—	4,373
Shetland	27,755	—	956
Stirling	141,894	23,873	—
Sutherland	21,389	—	507
Wigtown	32,591	—	3,471
Total	4,471,957	438,854	—

TOWNS WITH POPULATIONS OVER 50,000.

	Population.	Increase.		Population.	Increase.
Glasgow ...	760,423	142,371	Leith	76,667	6,782
Edinburgh ...	316,479	51,683	Govan	76,351	27,987
Aberdeen ...	153,108	29,781	Greenock ...	67,645	4,133
Dundee ...	100,871	5,196	Partick ...	54,274	17,736
Paisley ...	79,355	2,471			

III.—IRELAND.

POPULATION IN 1901.

LEINSTER	1,150,485	ULSTER	1,581,351
Carlow	37,723	*Antrim	461,240
*Dublin	447,266	Armagh	125,238
Kildare	63,469	Cavan	97,368
Kilkenny	78,821	Donegal	173,256
Kings	60,129	*Down	289,335
Longford	46,581	Fermanagh	65,243
Louth	65,741	*Londonderry	144,329
Meath	67,463	Monaghan	74,505
Queens	57,226	Tyrone	150,468
Westmeath	61,527		
Wexford	103,860	MUNSTER	1,075,075
Wicklow	60,679	Clare	112,129
CONNAUGHT	649,635	Cork, W.R.	131,668
		*Cork, E.R.	273,145
Galway	192,146	Kerry	165,331
Leitrim	69,201	*Limerick	146,018
Mayo	202,627	Tipperary, S.R.	91,227
Roscommon	101,639	Tipperary, N.R.	68,527
Sligo	84,022	*Waterford	87,030

* The populations of these counties include those of the county boroughs.

POPULATION OF THE LARGER TOWNS IN IRELAND.

Dublin	280,108	Londonderry	39,873	Municipal Boroughs.
Belfast	348,965	Limerick ...	38,085	
Cork	75,078	Waterford ...	26,743	

Rathmines and Rathgar ...	32,472	U.D.s in Co. Dublin.
Pembroke	25,524	

The decrease of the population which has taken place since the census of 1891 amounts to 5·3 per cent.

APPENDIX F.—A FEW CHEMICAL VALUES FOR READY REFERENCE.

ATOMIC WEIGHTS AND VALENCIES.

II.	Barium ...	Ba	137
II.	Calcium ...	Ca	40
II.	Carbon ...	C	12
I.	Chlorine ...	Cl	35·5
II.—IV.	Chromium ...	Cr	52·2
I.	Hydrogen ...	H	1
I.	Iodine ...	I	127
II.—IV.	Iron	Fe	56
II.	Lead	Pb	207
II.	Magnesium ...	Mg	24
II.	Manganese ...	Mn	55
II.	Mercury ...	Hg	200
III.—V.	Nitrogen ...	N	14
II.	Oxygen ...	O	16
III.—V.	Phosphorus ...	P	31
I.	Potassium ...	K	39·1
I.	Silver	Ag	108
I.	Sodium ...	Na	23
II.	Sulphur ...	S	32
	Double atoms.		
VI.	Chromium ...	Cr^2	104·4
VI.	Iron	Fe^2	112
II.	Mercury ...	Hg^2	400

MOLECULAR WEIGHTS OF SOME COMPOUNDS.

Ammonia	... NH^3	17
Ammonium oxalate...	... $(NH^4)^2C^2O^4$	124
Barium oxide ...	... BaO	153
,, hydrate ...	... BaH^2O^2	171
,, chloride ...	... $BaCl^2$	208
,, nitrate ...	... $Ba(NO^3)^2$	261
,, oxalate ...	... BaC^2O^4	225
Calcium oxide ...	... CaO	56
,, hydrate ...	... CaH^2O^2	74
,, carbonate ...	... $CaCO^3$	100
,, oxalate ...	... CaC^2O^4	128
Carbon dioxide ...	... CO^2	44
Hydric chloride ...	... HCl	36·5

Hydric nitrate	HNO^3	63
,, oxalate	$H^2C^2O^4$	90
,, sulphate	H^2SO^4	98
Potassium oxide	K^2O	94·2
,, hydrate	KHO	56·1
,, permanganate ...	$KMnO^4$	158·1
Bipotassium platinic chloride	K^2PtCl^4	448·7
Silver nitrate	$AgNO^3$	170
,, chloride	$AgCl$	143·5
Sodium chloride	$NaCl$	58·5
,, hydrate	$NaHO$	40

Analytical Equivalents for Estimation of

Chlorine. $AgNO^3 : Cl : NaCl : : 170 : 35·5 : 58·5$.

Lime. $\begin{cases} H^2C^2O^4 : CaH^2O^2 : CaO : : 90 : 74 : 56. \\ (NH^4)^2C^2O^4 : CaH^2O^2 : CaO : : 124 : 74 : 56. \end{cases}$

Sulphates. $\begin{cases} BaCl^2 : H^2SO^4 : : 208 : 98. \\ Ba(NO^3)^2 : H^2SO^4 : : 261 : 98. \end{cases}$

Nitrates. $NH^3 : HNO^3 : : 17 : 63$.

Nitrogen as Nitrates. $N : HNO^3 : : 14 : 63$, or $2 : 9$.

Carbonic dioxide. BaO or $CaO : CO^2 : : 153$ or $56 : 44$.

Lead. $PbS : Pb : : 239 : 207$.
Iron. $FeS : Fe : : 88 : 56$.
Copper. $CuS : Cu : : 95·5 : 63·5$.
But more easily by colorimetry.

Magnesium. $Mg^2P^2O^7 : Mg^2 : : 222 : 48$.
Potassium. $PtK^2Cl^6 : K^2 : : 488·7 : 78·2$.
The triple phosphate being reduced by ignition to pyrophosphate.

Ammonia in $(NH^4)^2SO^4$ as $17 : 132$.
Lead in $PbO^2(C^2H^3O)^2$ as $207 : 325$.

APPENDIX G.

STANDARD SOLUTIONS FOR WATER ANALYSIS.

Water.—All water must be distilled and free from any trace of ammonia.

For Determination of Free and Organic Ammonia.

Nessler's Sol.—Dissolve 62·5 grm. KI in 250 ccs water, put 1 cc aside. Dissolve 35 grms. $HgCl_2$ in 600 ccs *warm* water, and when cold add it gradually to the former till slight ppt. appears; re-dissolve this by adding drop by drop from the 1 cc KI sol. reserved. Then add 150 grms. KHO in 150 ccs water, and make up to 1 litre.

Alkaline Permang. Sol.—Dissolve 8 grams pot. permang. and 200 grms. KHO in 1100 ccs, and boil down to 1000, or till distillate is ammonia free. Make up to 1000 ccs again.

Standard Ammonia Sol.—Dissolve 3·15 gr. (NH^4) Cl. in litre for strong stock sol. For standard sol. pipette off 5 ccs of this in 495 ccs water.

For Determination of Chlorine.

Standard Silver Sol.—Dissolve 4·788 grm. $AgNO^3$ in 1000 ccs water. One cc water = ·001 gr. Cl. ∴ with 100 ccs of water, each cc = 1 pt. per 100,000 of Cl.

Indicator.—One pt. of pure Pot. monochromate in 10 of water.

For Determination of Nitrates.

Phenol Sulphuric Acid.—Add 6 grms. pure phenol and 3 ccs water to 37 ccs H_2SO^4, and digest for several hours at 100° C. or a little under.

Liquor Potassæ.—A 5 % sol. of pure KHO.

Standard Nitrate Sol.—Dissolve 0·722 grms. of recently fused KNO^3 in 1000 ccs water. Ten ccs = ·001 grm. N.

For Estimation of Nitrites.

Griess' Test.—Sol 1. Metaphenylene diamine, 5 grm. in 1000 ccs, acidulated with H_2SO^4. Sol. 2. Sulphuric acid, 35 %. Sol. 3. Standard nitrite sol.

Dissolve argentic nitrite, ·406 grm. in hot water, decompose by slight excess of KCl, decant clear solution off ppt. of AgCl., and dilute each 100 ccs with 900 ccs of water. Each cc of this sol. of KNO^3 = ·00001 gr., or ·01 mg. of N^2O^3.

For the Estimation of Oxygen Absorbed.

Potassium Permanganate Sol.—Dissolve 0·395 grm. in 1000 ccs. Ten ccs = ·001 grm. oxygen.

Sodium Thiosulphate Sol.—One grm. in 1 litre.

Dilute Sulphuric Acid.—One hundred ccs in 300 ccs water.

Potassium Iodide.—Ten % solution.

Starch Sol.—One grm. of rice starch worked to a cream with cold water, added to 100 ccs of boiling water, and boiled for two minutes. When cold decant off clear liquid. It must be used while fresh as it soon spoils.

For Estimating the Hardness.

Standard Soap Sol. is perhaps best obtained ready-made from chemists, when a table will be found affixed to the bottles showing the number of parts per 100,000 and "degrees of Clark's scale," or parts per 70,000 indicated by each cc and tenth of a cc required by 50 ccs of the water to be examined, corrected by the deduction of the 0·7 cc used up in the production of a permanent lather after the removal of the earthy salts. The solution tends to soon spoil, and the process of standardizing is too difficult for the frequent repetition necessary if the analyst prepares it himself.

I. HARDNESS TABLE (50 CC OF WATER USED).

Measures of Soap Sol.	CaCO3 per 100,000.	Degrees (Clarke's) of Hardness.	Measures of Soap Sol.	CaCO3 per 100,000.	Degrees (Clarke's) of Hardness.	Measures of Soap Sol.	CaCO3 per 100,000.	Degrees (Clarke's) of Hardness.
CC			CC			CC		
0·7	0·00	0·00	5·9	7·29	5·10	11·1	15·00	10·50
0·8	0·16	0·11	6·0	7·43	5·20	·2	15·16	10·61
0·9	0·32	0·22	·1	7·57	5·30	·3	15·32	10·72
1·0	0·48	0·34	·2	7·71	5·40	·4	15·48	10·84
·1	0·63	0·44	·3	7·86	5·50	·5	15·63	10·94
·2	0·79	0·55	·4	8·00	5·60	·6	15·79	11·05
·3	0·95	0·67	·5	8·14	5·70	·7	15·95	11·17
·4	1·11	0·78	·6	8·29	5·80	·8	16·11	11·28
·5	1·27	0·89	·7	8·43	5·90	·9	16·27	11·39
·6	1·43	1·00	·8	8·57	6·00	12·0	16·43	11·50
·7	1·56	1·09	·9	8·71	6·10	·1	16·59	11·61
·8	1·69	1·18	7·0	8·86	6·20	·2	16·75	11·73
·9	1·82	1·27	·1	9·00	6·30	·3	16·90	11·83
2·0	1·95	1·37	·2	9·14	6·40	·4	17·06	11·94
·1	2·08	1·46	·3	9·29	6·50	·5	17·22	12·05
·2	2·21	1·55	·4	9·43	6·60	·6	17·38	12·17
·3	2·34	1·64	·5	9·57	6·70	·7	17·54	12·28
·4	2·47	1·73	·6	9·71	6·80	·8	17·70	12·39
·5	2·60	1·82	·7	9·86	6·90	·9	17·86	12·50
·6	2·73	1·91	·8	10·00	7·00	13·0	18·02	12·61
·7	2·82	2·00	·9	10·15	7·11	·1	18·17	12·72
·8	2·91	2·09	8·0	10·30	7·21	·2	18·33	12·83
·9	3·12	2·18	·1	10·45	7·32	·3	18·49	12·94
3·0	3·25	2·28	·2	10·60	7·42	·4	18·65	13·06
·1	3·38	2·37	·3	10·75	7·53	·5	18·81	13·17
·2	3·51	2·46	·4	10·90	7·63	·6	18·97	13·28
·3	3·64	2·55	·5	11·05	7·73	·7	19·13	13·39
·4	3·77	2·64	·6	11·20	7·84	·8	19·29	13·50
·5	3·90	2·73	·7	11·35	7·95	·9	19·44	13·61
·6	4·03	2·82	·8	11·50	8·05	14·0	19·60	13·72
·7	4·16	2·91	·9	11·65	8·16	·1	19·76	13·83
·8	4·29	3·00	9·0	11·80	8·26	·2	19·92	13·94
·9	4·43	3·10	·1	11·95	8·37	·3	20·08	14·06
4·0	4·57	3·20	·2	12·11	8·48	·4	20·24	14·17
·1	4·71	3·30	·3	12·26	8·58	·5	20·40	14·28
·2	4·86	3·40	·4	12·41	8·69	·6	20·56	14·39
·3	5·00	3·50	·5	12·56	8·79	·7	20·71	14·50
·4	5·14	3·60	·6	12·71	8·90	·8	20·87	14·61
·5	5·29	3·70	·7	12·86	9·00	·9	21·03	14·72
·6	5·43	3·80	·8	13·01	9·11	15·0	21·19	14·83
·7	5·57	3·90	·9	13·16	9·21	·1	21·35	15·95
·8	5·71	4·00	10·0	13·31	9·32	·2	21·51	15·06
·9	5·86	4·10	·1	13·46	9·42	·3	21·68	15·18
5·0	6·00	4·20	·2	13·61	9·53	·4	21·85	15·30
·1	6·14	4·30	·3	13·76	9·63	·5	22·02	15·41
·2	6·29	4·40	·4	13·91	9·74	·6	22·18	15·53
·3	6·43	4·50	·5	14·06	9·84	·7	22·35	15·65
·4	6·57	4·60	·6	14·21	9·95	·8	22·52	15·76
·5	6·71	4·70	·7	14·37	10·06	·9	22·69	15·88
·6	6·86	4·80	·8	14·52	10·16	16·0	22·86	16·00
·7	7·00	4·90	·9	14·68	10·28			
·8	7·14	5·00	11·0	14·84	10·39			

II.

Ammonia in parts per 100,000 for each CC of Standard Sol.

(*Stand. Sol.* 1 CC = 0·00001 gr. NH^3. *Water taken,* 500 CC.)

CC of Stand.	NH^3 per 100,000.	CC of Stand.	NH^3 per 100,000.	CC of Stand.	NH^3 per 100,000.	CC of Stand.	NH^3 per 100,000.
1·0	0·002	5·75	0·0115	11·0	0·022	21·0	0·042
1·25	0·0025	6·0	0·012	11·5	0·023	22·0	0·044
1·50	0·003	6·25	0·0125	12·0	0·024	23·0	0·046
1·75	0·0035	6·50	0·013	12·5	0·025	24·0	0·048
2·0	0·004	6·75	0·0135	13·0	0·026	25·0	0·050
2·25	0·0045	7·0	0·014	13·5	0·027	26·0	0·052
2·50	0·005	7·25	0·0145	14·0	0·028	27·0	0·054
2·75	0·0055	7·50	0·015	14·5	0·029	28·0	0·056
3·0	0·006	7·75	0·0155	15·0	0·030	29·0	0·058
3·25	0·0065	8·0	0·016	15·5	0·031	30·0	0·060
3·50	0·007	8·25	0·0165	16·0	0·032	31·0	0·062
3·75	0·0075	8·50	0·017	16·5	0·033	32·0	0·064
4·0	0·008	8·75	0·0175	17·0	0·034	33·0	0·066
4·25	0·0085	9·0	0·018	17·5	0·035	34·0	0·068
4·50	0·009	9·25	0·0185	18·0	0·036	35·0	0·070
4·75	0·0095	9·50	0·019	18·5	0·037	40·0	0·080
5·0	0·010	9·75	0·0195	19·0	0·038	45·0	0·090
5·25	0·0105	10·0	0·020	19·5	0·039	50·0	0·100
5·50	0·011	10·5	0·021	20·0	0·040		

RULE.—Double the CCs and divide by 1000.

III.

Parts per 100,000 of Nitrogen as Nitrates for each CC of Standard Solution (Dr. Barwise).

(*Standard* = 1 per 100,000.)

No. of cc of yellow sol. equal to stand. 100 cc.	Nitrogen as nitrates, parts per 100,000.	No. of cc of yellow sol. equal to stand. 100 cc.	Nitrogen as nitrates, parts per 100,000.	No. of cc of yellow sol. equal to stand. 100 cc.	Nitrogen as nitrates, parts per 100,000.	No. of cc of yellow sol. equal to stand. 100 cc.	Nitrogen as nitrates, parts per 100,000.
100	**1·00**	68	1·47	**50**	**2·00**	32	3·13
95	1·05	66	1·51	48	2·08	30	3·33
90	1·11	65	1·54	46	2·17	28	3·57
85	1·18	64	1·55	45	2·22	26	3·85
80	1·25	62	1·61	44	2·23	**25**	**4·00**
78	1·28	60	1·67	42	2·38	24	4·17
76	1·32	58	1·72	40	2·50	22	4·55
75	1·33	56	1·78	38	2·63	**20**	**5·00**
74	1·35	55	1·82	36	2·78	18	5·55
72	1·39	54	1·85	35	2·86	16	6·25
70	1·43	52	1·92	34	2·94	15	6·67

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PART II.—SANITARY LAW.

Prefatory Note.—In arranging this part of the index on a wholly different plan, my aim has been to make it serve the purpose of a guide to the Sanitary Laws in general, and not only as set forth in this volume. It is always necessary and often sufficient to name the Act and Section bearing on any given case, and this system of *direct* reference cannot but tend to a more perfect knowledge of the law, since the eye so aids the memory that by frequent use of an index the subject and the reference become mentally linked, such association with *pages* only being useless save when one has the particular volume in one's hand.

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Definitions not given in this Abstract.

Drains and Sewers. "Drains" are such as are constructed to convey the foul waters, waste waters, slops, or sewage from one building only, or from buildings within the same premises, curtilage, or enclosure to a sewer, cess-pit, river, or other destination. The term is also used to describe any channels, open or closed, intended to carry off the superfluous moisture, ground or surface water, storm waters, and waters used in the irrigation of land, but rarely if ever occurs in this sense in sanitary law.

A "sewer" is a public drain, common to a number of separate houses or premises, the drainage from which it receives, and is vested in the Local Authority. The distinction is expressed in the phrases, a *private* drain and a *public* sewer.

"Sewerage" is the construction of, or collectively the system of, sewers; "sewage" is the liquid conveyed by sewers.

"Private improvements" are nowhere defined, save as implied in § 213 of the P.H.A. They are works executed by the L.A. for the sole benefit of a few owners, from whom the expenses are recovered by a special rate, for which they are assessed according to the rateable values of their respective properties, or in the case of paving, of their several frontages. The making of new streets and paving of the footways is in the first instance a P.I.E., but after notice given, the street is subsequently "dedicated" or taken over by the L.A., unless a majority of the owners object, preferring to retain control over it as a "private road," though with the burden of its maintenance as a perpetual P.I.E.

"Contributory places" are in like manner not explicitly defined, but [P.H.A. § 229] denote the permanent or provisional divisions of a Rural Sanitary District, which may be separately assessed to contribute to the cost of works (usually sewerage), undertaken by the L.A., wholly or mainly for their benefit, but which are vested in the L.A., and may be subsequently maintained from the general rate.

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